PRIMER
OF
HYGIENE

ERNEST S. REYNOLDS

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BY

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EXAMINER ON HYGIENE TO THE
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PREFACE

This Primer has been written for the use of higher grade school children, and for those who attend elementary lectures on Hygiene, as given in Evening Continuation Classes, Mechanics' Institutions, and University Extension and County Council courses. It is intended merely as a Primer, and the subject should be followed up in more advanced text-books.

Those matters only are dealt with which concern the health of the household, and these have been treated as simply as possible, in the hope that their observance in daily life may help to lessen the large amount of preventible disease which exists amongst us.

Manchester, *June* 1894.

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TROPICAL

PRIMER OF HYGIENE

CHAPTER I

INTRODUCTION

Definition.—Hygiene is a word originally derived from the Greek word *hygieia*, which means health. Nowadays we use the word to include all that extensive and varied knowledge which enables us to prevent disease; the science of hygiene being, in short, the science of preventing disease, so as to keep the individual and the community in a state of health.

Short History.—In ancient times in England no attempt was made to prevent disease, and as a result we read in our history books of the fearful and fatal outbreaks of sickness which spread through the country causing thousands of deaths. Thus there was the Black Death, which appeared in 1349, in the reign of Edward III., concerning which Green says: "Of the three or four millions who then formed the population of England, more than half were swept away in its rapid visitations. Its ravages were fiercest in the greater towns, where filth and undrained streets afforded a constant haunt of

leprosy and fever. . . . Nearly sixty thousand people perished in Norwich, while in Bristol the living were hardly able to bury the dead." Another well-known scourge was the Great Plague of 1665, which killed a hundred thousand people in London alone. The reason of these great epidemics was not far to seek, for although the population of the country was much less than at present, yet the towns themselves were small, walled in, and consequently very crowded; the houses were wretchedly constructed, the streets narrow, unpaved, and undrained; the home life, food, and general condition of the poor were disgraceful in the extreme, and with all this there was also a most deplorable ignorance of the sciences allied to medicine, such as we know them to-day.

After the Great Fire of London in 1666, which was one of the greatest blessings in disguise, a better state of things began. London itself had to be largely rebuilt, and this was carried out on a much healthier plan than before by Sir Christopher Wren. Houses were better constructed, streets were made wider, and the mass of the people began to realise the value of cleanliness, fresh air, and bright sunshine. As a result of better trade, there was more work for the people, and consequently better wages and better food; and during this century this has been especially the case since the introduction of railways and the telegraph, which formed a much more rapid means of communication between one part of the world and another. But apart from such indirect influences, we must remember the direct work in preventing disease which was done by such men as Captain Cook, who first showed us how we could prevent scurvy on board ship, of Howard,

who, investigating the bad condition of the jails, showed us how to prevent jail (or typhus) fever, and Edward Jenner, who, by the introduction of vaccination, showed us how to enormously lessen the evils of smallpox.

In the last thirty years we have had a whole army of earnest scientific workers, both medical and lay, who have spent their lives investigating the causes of disease, and have taught us how a very large number of illnesses and deaths may be prevented. This good work is still continuing, and is perhaps more active at the present time than it has ever been.

It is not sufficient that scientific men should find out how diseases may be prevented, or even that laws should be made by Parliament for the same purpose. It is absolutely necessary that the whole mass of the people should be made to understand the prevention of disease, so that they can carry out the suggestions of scientific men in their own homes. We can therefore see that the Education Act of 1870, which insisted on every boy and girl having a good sound education, is one of the greatest laws ever passed for the improvement of the morals and health of the people.

As proofs that this sanitary work has been of great value and saved many lives, I may tell you that the annual death-rate in England has been steadily decreasing during the last twenty years, that whereas it was 22·6 per 1000 people living for the period 1862-71, it was only 18·6 per 1000 for the five years 1886-90. This represents the saving of thousands of lives. Then we find that wherever a town has been properly drained and sewered,

there has resulted a great lessening of the number of deaths from consumption and typhoid fever. Nowadays smallpox is a much less terrible and fatal disease than it used to be, and widespread epidemics of cholera in England are practically unknown now that communities are supplied with good water, and proper inspection of ships coming from cholera-infected ports is thoroughly carried out.

Instead of regarding disease, as our forefathers did, as due to the judgment of Providence, or as the work of demons and witches, science has taught us that we must look upon it as very greatly caused by the neglect of the laws of health; in fact, we know that diseases can be divided into those which are preventible and those which are non-preventible.

Preventible and Non-preventible Diseases.—These two names are so simple that they explain themselves. As examples of preventible diseases I may give measles, smallpox, consumption, and the diseases due to alcohol; and as non-preventible diseases, cancer, and many forms of nervous disease. It is easy to understand, however, that the more our knowledge of the causes of disease increases, we shall find that more diseases are preventible than we at present imagine. Thus a few years ago it was supposed that consumption was a non-preventible disease, whereas we now know that it is one of the most preventible; and it is similarly possible that in a few years we may find that cancer is as preventible as we now know consumption to be.

To give you an idea of the enormous number of deaths from preventible disease occurring each year, let us examine the returns of the deaths in England and Wales in 1891 given by the Registrar-General.

The total number of deaths during that year was 587,925; of these 79,362 were due to infectious diseases, 46,515 to consumption, and 16,688 to accidents, or altogether 142,565 deaths from entirely preventible causes—being about one quarter of the total number of deaths from all diseases.

In addition to all this mortality we must remember that there is an even greater amount of sickness due to preventible disease, and that sickness means not only suffering, but much loss of money to the person and to the community.

It is thus seen that the study of hygiene may indeed be called the study of preventible diseases, their nature and their prevention.

Causes of Disease and Order of Book.—In all the requirements of life and in all our work we shall find many circumstances which may cause disease, and which we must therefore avoid. In the air we breathe, in the water we drink, the food we eat, in the clothes we wear, in our habits and occupations, and last, but by no means least, in our houses, we shall find diseases lying in wait for us, as it were, and which we can only conquer by a closer inspection and thorough knowledge of their methods of attack.

We shall in this primer examine these diseases in the order given in the last paragraph. But as it is being found out more and more every day that a large number of preventible diseases are entirely due to our bodies being attacked by certain living organisms which prey upon us and cause disease, it will perhaps be better to make a special study of these parasites, as they are called, before going further.

QUESTIONS

1. What is the meaning of the science of hygiene?
2. What improvements have resulted from the use of hygienic measures in England?
3. Give some examples of preventible and of non-preventible diseases.

CHAPTER II

PARASITES AND THEIR ACTION ON THE HUMAN BODY

Definition. — The word parasite comes from the Greek word *parasitos*, which literally means a person who lives at another's table or at another's expense. In English, however, the term is not generally used in this sense, but is usually applied to certain living bodies which live at the expense of other living bodies. As examples, we have the ivy living at the expense of the oak, the mistletoe on the apple-tree, the phylloxera on the grape vine, and the flea on man and other animals. These are all "parasites," and the thing on which they live and grow is called the "host." As a result of such growth, sickness, and even death of the host may ensue, as when the tree, overgrown with ivy, gradually sickens and dies. In medicine, however, we have only to consider those parasites which live on man, and we can easily see that any diseases they may cause are preventible, for if we can stop the parasite attacking man, we can prevent the disease it would have caused.

Nature.—Parasites attacking man may be either animal or vegetable, and they may attack either the

external surface, such as the skin or hair, or may attack the internal organs. We must now examine them in more detail.

Animal Parasites.—The commonest attacking the external parts, such as fleas, bugs, lice, and mosquitoes, are generally well known. They cause much irritation, with small lumps on the skin, and scratching leaves many marks on the body. The

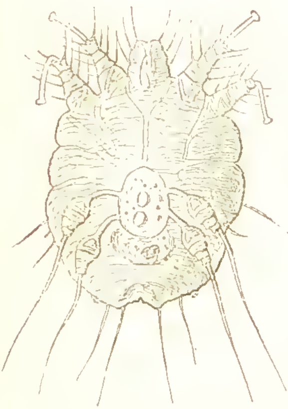


FIG. 1.—The itch insect.

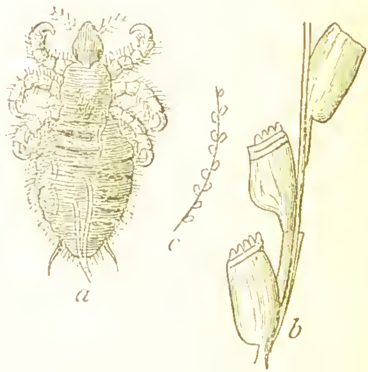


FIG. 2.—*a*, The head louse; *b*, nits on hair (magnified); *c*, same (nat. size.)

itch insect (Fig. 1) is very minute and microscopic, but as the female burrows under the skin and lays her eggs, small papules and pustules form, with very great irritation, and the body may be almost covered with an unsightly eruption. This disease can be communicated by touch to others. The head louse attacks the hair, and may be seen crawling about, or its eggs or "nits" can be seen fixed on to the hairs themselves (Fig. 2). It causes much irritation, eruptions on the head, and lumps at the back of the neck.

The animal parasites attacking the internal parts of the body are numerous. The commonest are tape-worms (Fig. 3), which get into the body with diseased meat of the cow or pig, and cause much irritation from their presence in the small intestine; the common round worm (Fig. 4), about 12 inches long, which also lives in the small intestine; and thread or seat worms (Fig. 5), in the lower part of

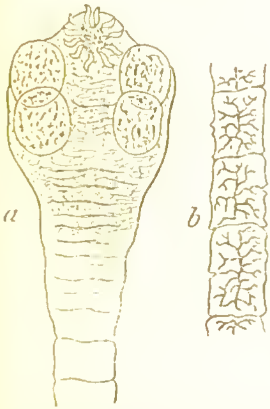


FIG. 3.—The tape-worm. *a*, Its head (magnified); *b*, joints (natural size).

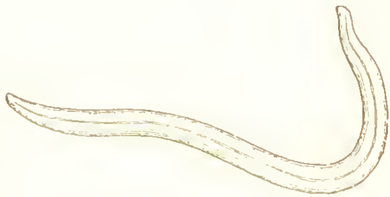


FIG. 4.—The round worm.

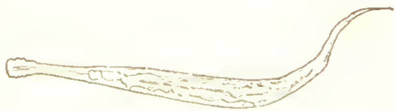


FIG. 5.—The seat worm.

the large intestine, causing great discomfort. Very rarely in this country another minute worm, the trichina, gets into the intestines and muscles of man from similarly diseased pork (see p. 64). It is not easily killed or expelled if it has once got into the body. The other worms mentioned may be easily expelled by simple medicines, and any discomfort which they may have caused is thus removed. Another internal animal parasite, which is fortunately not very common, is the "bladder" form of the tape-worm of the dog. This bladder may begin

to grow in some organ (generally the liver) of the human body, and cause great suffering, and even death, from its large size. It can only be removed effectually by a surgical operation.

Vegetable Parasites.—As we have just seen, the animal parasites are generally large enough to be seen by the naked eye. The vegetable parasites attacking the body are, however, all very minute, and only visible by the microscope, and their presence on or in the body is only judged from the diseases which they set up. They attack either the external or

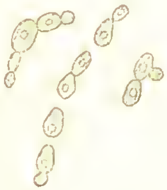


FIG. 6.—The yeast plant.

FIG. 7.—Ringworm fungus in hair.

internal parts of the body. They may be all included under the one head of **germs or micro-organisms.** These are small, generally microscopic organisms of the lowest forms of vegetable life. Three familiar examples will illustrate them. You all know that if milk is allowed to stand for a short time it will become sour; this is due to the growth in the milk of a minute rod-shaped germ, which during its life and growth in the milk decomposes the sugar of milk (lactose) and forms lactic acid. Again, if we put some ordinary yeast in a solution of cane sugar, the latter is decomposed, and carbon dioxide, water, and alcohol are formed, and at the same time the germ rapidly grows. A third example of germs

growing may be seen in the fungus or mould which will grow on old boots. Some of these germs, such as the yeast plant (Fig. 6), grow and multiply by giving off buds; a second group, such as the various

FIG. 8.—Micrococci from pus.

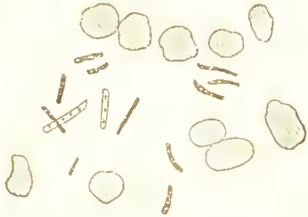


FIG. 9.—Tubercle bacilli in sputum.

moulds, by branching and by small spores or eggs (Fig. 7); and a third group, such as the milk-souring germ, by dividing, and also by spores (Figs. 8 to 11). It is in the two latter groups that we find the vegetable parasites which attack man.

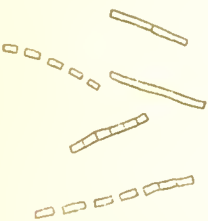


FIG. 10.—Anthrax bacilli.

FIG. 11.—Cholera spirilli.

From the second group, or the branching germs, we find attacking the external part of the body the ringworm, which, in spite of its name, is not a worm at all; it attacks the hair of the head, and occasionally the skin of the rest of the body, and causes a ring-like eruption, with breaking and falling out of

the hair. It can be communicated from one person to another. There are one or two other skin eruptions caused by branching germs, but they are not so common. Thrush, consisting of little white sore patches, especially found in the mouths of young children, is due to the growth of another branching parasitic germ.

It is, however, the third group of germs that is the most important, for here we find those which, on attacking the body, cause a large number of infectious diseases. It is probable, nay, almost certain, that all infectious diseases are caused by germs, and although, curiously enough, we do not yet know the exact germ which causes some of the commonest diseases, such as measles and smallpox, yet we know well those which cause cholera, consumption (phthisis or tuberculosis), typhoid fever, leprosy, diphtheria, and many others. Of late years a large number of scientific men have been studying these germs, and a new science has arisen called bacteriology, and we now speak of the **germ theory of disease**.

The little bodies in this third group are sometimes called **bacteria**, from the Greek *bakterion*, a staff. They vary greatly in shape and size. Some of them, called **micrococci** (Fig. 8) (Gr. *mikros*, small; *kokkos*, a berry), are merely round bodies like minute beads, so small that 25,000 of them, if they could possibly be strung together, would only reach across a halfpenny (one inch in diameter); others, the **bacilli** (Figs. 9 and 10) (Lat. *bacillus*, a little staff), are rod-shaped, and vary in length from $\frac{1}{1000}$ inch to $\frac{1}{6000}$ in length; while others, the **spirilli**, such as the cholera germ (Fig. 11), are of

a spiral or corkscrew shape. Some of them move about by means of very minute whip-like tails, but others are quite stationary.

It was at first supposed that these germs could arise spontaneously from dead matter, but now we know that this is not the case; that just as every boy or girl must have a father and mother, so every germ must have arisen from some previous germ. And further, we think, though it is not absolutely proved, that one kind of germ can only give rise to the same kind of germ as itself, that is, that a cholera germ can only be born from some preceding cholera germ, and a consumption germ from a consumption germ, and so on. These are very important points, as will be further seen when we are speaking of the infectious fevers.

How Germs cause Disease.—When germs attack or enter the body they commence to grow, and so set up inflammation in various parts, being carried in some cases, as in consumption, to nearly all parts of the body. Some of them, such as the diphtheria germ, only grow in one part, such as the throat, but during their growth they manufacture certain poisons, just as the yeast plant while growing manufactures alcohol, and these poisons are absorbed by the blood, and so taken to various parts of the body, and cause disease and death.

These little, almost invisible enemies of man are found in multitudes in the air, forming part of the dust of the atmosphere, in food, in water, and in various matters given off by the bodies of persons suffering from the diseases which they have caused. Thus we must be constantly taking them into the body from all these various sources.

How the Body resists the Germs.—If germs are so universal it will be asked, "How is it that we do not all suffer from the diseases they cause? How can any one escape?" Several theories have been brought forward as an explanation of this. One of the most easily understood, and certainly the one which teaches us the most, is as follows: It is supposed that there are in the body a large number of cells, like the white blood-cells, whose duty it is to attack, destroy, and remove all foreign and harmful material particles which enter. This they are supposed to do by practically eating such particles. It has been imagined that when the harmful matter is alive, as is the case with germs, a fight takes place between the cells and the germs. If the cells are strong, healthy, and in sufficient numbers they win the fight, destroy the germs, and no disease results: if the cells are weak or few in number the germs feed on them, win the battle, attack the rest of the body, and set up disease (Fig. 12). Now a very practical point arises here which is easy to see. If a person is always in excellent health, with all his organs and functions in good condition, any germs entering the body will have a very poor chance in the fight, and the person will escape disease. If, however, the health is not good, the person being in bad condition from cold, overwork, insufficient or

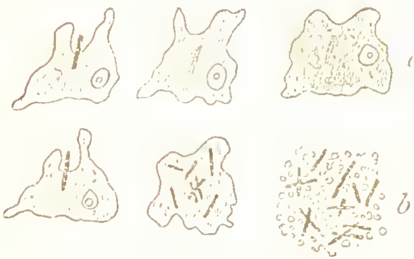


FIG. 12.—*a*, Germ destroyed by cell; *b*, cell destroyed by germ.

bad food, dissipation or alcoholic excess, then the germs will win, and disease will be set up. When epidemics are raging special care should be taken by all that they do not get "run down" or in bad condition. Cholera, for instance, when in a district does not attack every person, but only those who are not in first-rate health, and especially those who are already suffering from some affection, however slight, of the stomach or bowels.

When a person is exposed to disease germs (which may even get into his body), but no disease results, he is said to possess an "**immunity**" to that particular disease. As I have just said, immunity may be due to the fact that a person's tissues resist and kill the germ; in other cases immunity is set up by a person having already had the particular disease, as in the case of small-pox, which very rarely attacks the same person twice. Why this is so we do not quite understand, as in other cases, such as erysipelas, one attack rather leads to a second than prevents it. A third and extremely important and interesting method of causing immunity is that brought about by vaccination, which I shall describe later on.

I must finally point out that I do not want to make you believe that all diseases are due to germs and parasites, but that only a certain number are. Inasmuch, however, as all parasitic and germ diseases are so readily prevented by proper care, I thought it was better to explain at once what these parasites and germs are, and how they cause disease.

QUESTIONS

1. What is a parasite, and give some examples of the animal parasites which attack man?
2. What are germs, and how do they cause disease?
3. How does the body resist the attack of germs?

CHAPTER III

AIR AND ITS IMPURITIES

A SUPPLY of air is the first thing needed by a newly-born child. Without air men and animals could not exist, but would die in a few minutes after the supply had ceased. The air breathed is, of course, the same as the atmosphere, and consists of a mixture of several gases. In 10,000 parts of pure air we find 2096 parts of oxygen, 7900 of nitrogen, and 4 of carbon dioxide, with a slight amount of watery vapour, ammonia, and ozone, the last being a kind of condensed oxygen. Of these bodies oxygen is by far the most important for animal life, being the gas which is carried by the red blood-cells from the air spaces in the lungs to the various parts of the body, thus enabling the most important chemical changes in the body to proceed. It is also the gas which is essential for combustion.

Combustion.—If we examine for a moment the process which goes on when a candle burns, we shall more easily understand the processes of combustion going on in the animal body. When a candle is burning, the carbon in the wax combines with the oxygen of the air, and carbon dioxide is

formed and given off into the atmosphere; similarly, the hydrogen in the wax combines with the oxygen, and water is produced and given off as an invisible vapour, which can be condensed if a cold substance is held over the flame. As a result of both these chemical changes, heat and light are produced.

Respiration.—Similarly, the oxygen of the atmosphere is taken by inspiration into the lungs, combines with the colouring matter of the blood, and is carried, as I have said, to the various organs of the body, where it oxidises or burns up various tissues of the body, and at the same time work, both muscular and mental, is produced, this work corresponding to the light of the candle. As a further result of these processes, heat is formed, and certain waste products, amongst which are carbon dioxide and water (just as was the case with the burning candle), are given off. And we may continue the illustration further, for if we put a lighted candle in a closed bottle, it will burn for a time, but, having used up all the oxygen in the bottle, will go out; similarly, if a man were shut up in an air-tight room he would continue to breathe for a time, but would die of suffocation when the supply of oxygen was exhausted.

Functions of Constituents of Air.—The **oxygen** of the atmosphere is necessary to support combustion and animal and vegetable life. It is, however, such a strong chemical agent that, if the air were composed of it alone, all processes of oxidation would go on too rapidly. Its effect is therefore lessened or weakened by its admixture with a large quantity of **nitrogen**, which, so far as we know, has no other duty. The **carbon dioxide** in air is

probably also of no use to animals, but is essential to plants, as they use it to a considerable extent as their food, splitting it up into carbon, which they take into their own tissues, and oxygen, which is set free in the atmosphere. The **watery vapour** is of much importance, as may be told by the discomfort produced by breathing for a length of time a very dry air.

The Impurities of the Air.—Unfortunately, pure air is seldom met with except in the country, at the sea-side, or on mountains. Many impurities are found in the air breathed by most of us, and these have been divided into the **gaseous** and the **solid.**

Gaseous impurities are either compounds of carbon, as carbon dioxide and carbon monoxide; of sulphur, as sulphur dioxide, sulphuretted hydrogen, or sulphurous acid; of nitrogen, as ammonia; or they consist of fetid organic impurities, the nature of which is not exactly known. Of these the carbon dioxide and the organic vapours are the most harmful, and the total amount of the former should not exceed 5 or 6 parts in 10,000 parts of air.

Solid impurities are practically the "dust" of the atmosphere, such as can be seen when a strong ray of light passes through the air of a room, and they are known familiarly as the "motes in the sunbeam." The composition of this dust naturally varies according to the surrounding district, the sandy dust of the desert raised by the wind being different from the dust in the rooms of a cotton mill. So we may have an immense variety of solid impurities; they may consist of solid mineral particles, as sand, chalk, coal, lead, iron, flint, arsenic; of vegetable matters, as germs and their spores, the pollen of flowers, particles of flax and cotton; or of animal matters,

such as scales from the skin, minute cells from the lining membrane of the mouth or air passages, particles of hair, wool, or silk, and so on. Of these solid impurities the most harmful are the germs, which we have already studied and shall refer to again when we speak of the fevers.

Source of Impurities

Combustion.—During the combustion of different materials, such as wood, oil, coal, coal-gas, a large amount of gaseous impurity is produced, as carbon dioxide, carbon monoxide, sulphur dioxide, sulphurous acid, carbon bisulphide, etc. To show how great the impurities of combustion are, I may mention that 1 cubic foot of coal-gas in burning uses up the oxygen of 8 cubic feet of air, and gives off 2 cubic feet of carbon dioxide and about half a grain of sulphur dioxide. When it is remembered that a small gas burner will burn 3 cubic feet of gas in an hour, it will be seen how coal-gas burning in a sitting-room will poison the atmosphere; we can also understand how the innumerable fires burning in a large town help to make the air so bad as compared with the air of the country.

Respiration.—Pure air when inspired contains, as we have said, 2096 parts of oxygen, 7900 parts of nitrogen, and 4 parts of carbon dioxide in 10,000 parts. The air expired from the lungs by man contains in 10,000 parts, 1603 parts of oxygen, 7900 of nitrogen, 438 of carbon dioxide, together with a large amount of watery vapour and various unknown poisonous organic matters in small quantity.

We can now easily understand how it is that pure air becomes poisoned by respiration, the specially dangerous products being the carbon dioxide and the organic matters. The total amount of carbon dioxide breathed out in an hour is about ·6 cubic feet; but it has been found that although this is such a poisonous gas, yet it is probable that the bad effects of breathing respired air are more due to the poisonous organic matter, as it is found that while an artificial atmosphere containing 1 part of carbon dioxide in 100 of air causes but little discomfort when breathed, yet if an already respired air containing only 1 part of carbon dioxide in 1000 of air is breathed much discomfort is experienced. This organic poison is probably composed partly of an organic vapour from the lungs, and partly of solid matter from the lining of the mouth and air passages. It is difficult to find out the exact quantity of organic matter present, but it varies exactly in proportion to the quantity of carbon dioxide, and the amount of this in respired air is therefore taken as the standard of impurity.

The Air from Sewage and Sewers.—This is found to contain a great diminution of the oxygen, a large increase of the carbon dioxide, and many other gases, such as sulphuretted hydrogen, sulphide of ammonium, marsh-gas, etc. A more harmful constituent, however, is found in the numerous germs present, which are probably thrown into the air of the sewer by the bursting of bubbles on the surface of the putrefying sewage.

The air from churchyards contains carbon dioxide in excessive amount, various vapours of ammonia, offensive and putrid gases, and many germs.

Air polluted by Trades.—These impurities depend, of course, on the nature of the trade. We may have hydrochloric acid, sulphur dioxide, sulphurous acid, ammonia, and sulphuretted hydrogen from chemical works; carbon dioxide and monoxide and sulphuretted hydrogen from brickfields; nauseous organic vapours from glue refining, bone burning, fat boiling, candle making, and slaughter houses; and various vegetable and mineral impurities from near works where cotton, linen, flint, or iron particles are thrown into the atmosphere. Nor must we forget the air of work-rooms polluted by various products of manufacture, such as lead, phosphorus, flax, etc., to which I shall refer later.

The **air of towns** must necessarily be very impure, owing to the presence of the injurious products given off by combustion, respiration, sewers, and trades; we find a lessened amount of oxygen, an increased amount of carbon dioxide, and a fairly large amount of solid matter, both inorganic and organic. It is also found that it is especially in the narrow streets of crowded parts of the town that the atmosphere is particularly foul, in the open spaces and wide streets the impurities being not nearly so great.

In **close rooms** the air is made impure by products of combustion (as from the burning of gas) and by respiration; the impurities thus caused may be very great, even to the extent of 3 parts of carbon dioxide in 1000 of air. In a room in Leicester, containing six persons, with only 51 cubic feet of air space each, and with three gas-lights burning, the amount of carbon dioxide was found to be over 5 parts per 1000 of air.

Self-purification of Atmosphere.—It may be asked how it is that, considering the large number of impurities constantly entering the atmosphere, it does not become too foul to breathe at all. The fact is that in nature there is a wonderful series of processes always going on which tend to purify the air. Firstly, there is the diffusion of gases, by means of which the different gases in the atmosphere, although of unequal weights, are constantly on the move so as to be thoroughly mixed up; the heavy carbon dioxide in this way is prevented from accumulating near the surface of the earth as a thick poisonous layer, but mixes freely with the other gases which are lighter. Secondly, the wind is constantly mixing the various gases together; thirdly, many of the impurities are decomposed, or oxidised, or washed down by the rain; and lastly, there is the great purifying process of the vegetable world, which is constantly decomposing the carbon dioxide and setting free the oxygen, and so tending to keep up the proper relation between the two.

Standard of Purity.—We have seen that pure air contains about 4 parts of carbon dioxide per 10,000 parts, and we have also stated that we may use the amount of carbon dioxide in the air as a guide to the amount of the other impurities. Now, it has been found by experiment that when the air of a room contains more than 6 parts of carbon dioxide in 10,000 parts, it begins to smell close and stuffy to any one coming in from the fresh air outside (although those who have been in the room for some time will not notice any closeness). This, then, has been taken as the greatest total amount of carbon dioxide which should be present in air to be breathed, and consists,

of course, of the four parts of carbon dioxide in pure air, and two parts of carbon dioxide added from combustion and respiration. Seven parts of carbon dioxide per 10,000 of air would make the atmosphere slightly close, and ten parts would make it very close.

Diseases produced by Various Impurities of Air

(*a*) *Impure from Respiration.*—The effect upon most people of breathing over-respired air is to cause heaviness, sleepiness, headache, giddiness, fainting, and sometimes vomiting. When the air is still more impure death may result, as in the case of the 146 prisoners kept in the Black Hole of Calcutta for a single night, of whom 123 died; and also when 150 passengers were shut up on a very stormy night in a small cabin of the steamer *Londonderry*, of whom 70 died before morning. The breathing of impure air day after day causes people to become pale, lose their spirits, strength, and appetite, and, as a result, they easily contract any infectious disease which is in the district; and this remark especially applies to consumption, which is particularly common in communities who live in bad impure air, and the frequency of which tends to diminish in proportion as the air habitually breathed is improved; the same remarks as regards consumption apply to other animals than man, as it is seen in monkeys living in ill-ventilated cages and in cows in stuffy shippons.

(*b*) *Impure from Combustion.*—The solid particles of carbon from the smoke of fires, and the fumes of burning sulphur, are harmful to the respiratory

apparatus. The gaseous products, such as carbon dioxide and carbon monoxide, may cause death if present in large quantities, and even in small quantities cause pallor, headache, heaviness, and oppression.

(*c*) *Impure from Sewer Gas.*—If an atmosphere is very largely contaminated with sewer gas, death may rarely result. In smaller quantities this form of impurity will cause sleepiness, headache, loss of appetite, vomiting, diarrhœa, colic, and prostration. Diarrhœa, typhoid fever, and almost certainly diphtheria are not uncommonly set up by sewer gas getting into houses, but at present there is no certain proof that scarlatina can be caused in this way. The air coming from rivers polluted with sewage, or from land on to which sewage has been thrown, has been known to cause dyspepsia, and even dysentery.

(*d*) The *Air coming from Marshy Ground* will cause ague. This is very common in the tropics, and used to be common in certain districts in this country, but is now almost unknown here since this kind of land has been well drained and cultivated.

(*e*) *Air polluted by Trades.*—Workers exposed to coal dust and steel dust, potters, workers in flax, and others engaged in dusty occupations are specially apt to suffer from diseases of the lungs. It has been estimated that the mortality from lung diseases is three or four times as great amongst artisans as amongst the rest of the community, partly from the dust of occupations, and partly from the unventilated houses of the working class. Lead poisoning not unfrequently occurs from lead dust from dyed goods, and wool sorters occasionally get a fatal disease called anthrax from germs coming from the wool of animals which have been similarly affected. Phos-

phorus poisoning used to be very common in match-making works from the phosphorus fumes, and workers in macintosh manufactories occasionally suffer from paralysis and mental troubles from the vapours of carbon bisulphide in the air of the work-rooms.

QUESTIONS

1. What is pure air composed of, and what changes occur in it during combustion and respiration?
2. Mention some of the impurities of the air and give their source.
3. How does the air get naturally purified, and what is the "standard of purity"?
4. What diseases are caused by impure air?

CHAPTER IV

WATER AND ITS IMPURITIES

WATER is one of the first necessities of life, for without it man could only live a comparatively few days. It enters very largely into the composition of the animal tissues, is one of the most important elements of food, is essential to the many chemical changes going on in the body, and helps to get rid of the poisonous excretions of the body. It is used extensively in cooking, and is the universal cleanser; being used also on a large scale for removing all forms of sewage and for manufacturing purposes.

Absolutely pure or distilled water is composed of two parts of hydrogen and one of oxygen; this is rarely, if ever, met with in nature, but only in the chemist's laboratory. The original source of all natural water is the watery vapour of the atmosphere, which is condensed, and falls on the earth either in the form of hail, snow, rain, or dew. Of this downfall a certain amount goes directly to the seas or lakes; another portion sinks into the soil, and passing through the various porous strata or through fissures in the rocks, reappears again in the form of springs, or is retained and collected under the surface

in the form of wells. A third portion evaporates directly after falling, and the remainder is absorbed in the chemical composition of minerals, or is utilised in the processes of growth and decay of animal and vegetable life.

Sources of Water Supply

1. *Rain Water.*—This is, when untainted by the receiving surface or by the atmosphere through which it passes, a very good water, healthy and fairly pleasant to drink, and excellent for cooking and washing purposes. In country districts and in many towns having a pure atmosphere, such as Venice, the rain is carefully collected from all possible receiving surfaces and stored in some way, often in subterranean cisterns, and used for all purposes. In most towns, however, the atmosphere and the receiving surfaces are so impure that the water would carry down and dissolve these impurities, and so be unfit for drinking purposes, but would be useful for washing. Moreover, in many places the rainfall is too uncertain for a population to depend on this alone for its supplies.

2. *Surface Water.*—The rain having fallen, a certain amount, as has been already said, passes through the soil and reappears in various forms and in various states of purity, depending on the character of the soil through which it passes. The solution of the soil is much aided by the presence in the water of a considerable amount of carbon dioxide, which it obtains from the spaces in the soil itself. The water in this way may, in fact, become so highly charged with salts as to be unfit for ordinary human consumption, being, indeed, only suitable for medi-

cinal purposes, as the brine waters of Droitwich, or the iron waters of Trefriw. If, however, the water does not dissolve much of these substances, and only passes through soil which is at a higher level than any house, it may be quite safe, and may be collected in a well or drawn from a spring. If, on the contrary, the land is cultivated, and consequently manured with excreta, or if it is low-lying and below or in the midst of houses, then the water would probably dissolve much poisonous material, and would be quite unfit for use (Fig. 13).

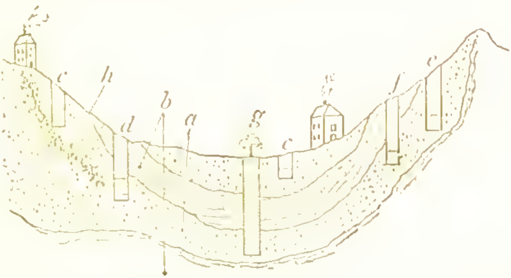


FIG. 13.—Sources of water supply. *a*, sand; *b*, rock; *c*, surface wells (impure); *d*, deep well (impure); *e*, surface well (pure); *f*, deep well (pure); *g*, Artesian well; *h*, sewage in soil.

3. *Deep Water.*—In many valleys it is, however, possible to secure a good and pure supply of water both from springs and wells, owing to the nature of the ground. All the water from the neighbouring hills penetrating the soil gets deeper and deeper as it flows in the soil towards the valley. It often happens that on reaching the valley this deep layer of soil containing the water is cut off from the surface soil of the valley containing impure surface water by a water-tight or impervious stratum of earth, such as clay or some hard rock. If there is a natural crack in this water-tight layer, the deep pure

water will issue through as a deep-seated spring. Or by boring through the layer a well may be sunk in the deep stratum, forming a deep well of pure water (Fig. 13). An Artesian well is a deep well in which the level of the ground water on the neighbouring hills is so high that the water rising in the deep well in the valley overflows at the mouth (Fig. 13). It will thus be seen that the difference between a shallow well and a deep well is not one of mere depth, but depends on the existence in the latter case of a water-tight layer, through which the well is bored. Deep water varies in composition according to the kind of soil through which it percolates. If from very marshy ground, it may contain as much as 20 to 120 grains of solid matter per gallon, and often much organic impurity, so that it may be unfit for use. If it has passed through a chalky soil, it will be clear, wholesome, and sparkling, but not very good for washing and cooking purposes, as it will contain much chalk, and so be very hard; similarly, water from limestone or magnesium limestone will be hard, from the presence of sulphate of lime and magnesium. If the water has come from granite, slate, millstone grit, or sandstone, it will be very pure and good for all purposes.

In speaking of deep wells and springs it should be mentioned that although they may give a sufficient supply for a small community, yet they are not sufficient for a town supply; for as the population grows and more water is required, additional deep wells in the same district will yield but a small increase of water.

4. *River Water.*—Similar remarks as regards purity apply to river water. It is, as a rule, softer

than spring water, and may be very pure if taken from a spot quite above any source of sewage contamination. It is often bright and sparkling from the constant movement of the stream, and is very largely used for all purposes, London, for instance, receiving practically all its water from rivers.

5. *Lake Water.*—This, again, especially if the lake is in the mountains, yields a very pure water, and is the source of some of the best water supply in this country, as the Glasgow water from Loch Katrine, the Manchester water from Thirlmere, and the Liverpool water from the artificial lake Vyrnwy.

6. *Distilled Sea Water.*—On shipboard sea water is now often distilled, and the resulting pure water if too tasteless can be aerated.

The following table has been drawn up by the River Pollution Commissioners as regards the wholesomeness and palatability of the various kinds of water mentioned:—

Wholesome	1. Spring 2. Deep well	Very palatable.
	3. Upland surface	Moderately palatable.
Suspicious	4. Stored rain	
	5. Surface from cultivated land	Palatable.
Dangerous	6. River water with sewage 7. Shallow well	

The Storage of Water.—Water may be stored merely in tubs or in cisterns, as is the case with rain water; in wells, with surface and deep water; naturally stored in lakes, or artificially in constructed lakes, or, as they are generally termed, reservoirs. In isolated country districts rain, well, or spring water

collected as above has to suffice; but in the case of towns this is not sufficient, and the water is stored in lakes and reservoirs, and brought to the towns generally in large iron pipes. It is then distributed to the houses either constantly, or only at certain hours in the day, that is, intermittently, being stored separately in each house in the latter case in a cistern. This system of intermittent supply is a bad one, as the chance of pollution from a dirty cistern or other source is very great. Its object is to save water, but it is somewhat doubtful if it does so.

The house cistern should be made of a material like galvanised iron or slate, which will not impart any injurious quality to the water. Lead and wood are both very bad. House cisterns should be placed where they can be easily got at, so that they may be regularly cleaned. They should be covered in and ventilated. The overflow pipe should be carried outside, be quite short, and open freely to the air, so that if there is any overflow it will be at once noticed. The water supply for the water-closet must be in an entirely separate cistern.

Amount required per Day for each Person.—This has been given as follows:—

For man:—	Cooking	·75	gallons
	Fluids as drink	·33	,,
	Ablution, including daily sponge bath	5·00	,,
	Share of utensil and house washing	3·00	,,
	Share of clothes washing	3·00	,,
		12·08	,,

In calculating for a town supply we allow for each person :—

Domestic supply (as above, with water-closet)	12 gallons
For general baths	4 ,,
Water-closet	6 ,,
Unavoidable waste	3 ,,
Town and trade purposes and animals .	5 ,,
Add for exceptional manufacturing towns	5 ,,
	35 ,,

Character of Good Drinking Water.—Good drinking water must be clear, free from odour and taste, cool, and sparkling with good aeration. It must be chemically fairly pure, that is, must not be too hard, must contain no organic matter, and not too great an excess of salts.

Hard and Soft Water.—A water is said to be hard when it does not easily produce a lather with soap. This is due to the presence in it of salts of lime, particularly the carbonate and the sulphate. If it is only the carbonate which is present, it is said to be temporarily hard, because by boiling, the carbon dioxide is driven off and the carbonate of lime is thrown down. If the sulphate is present, however, it is a permanently hard water, as this cannot be removed by boiling. A soft water easily lathers with soap, because it contains no large quantity of either lime or other salts.

Impurities of Water.—These may get into the water either at its source, during transit from

its source to its storage, from its storage, or during its final distribution.

(*a*) *Source.*—These have been mostly mentioned already. Water from granite, metamorphic, trap, and clay slate, millstone grit, sandstone and loose sand are pure, though the two last may contain chemical and organic matter. Chalk, limestone, and magnesium limestone yield good but hard waters. Alluvial, surface, and subsoil waters are, as a rule,

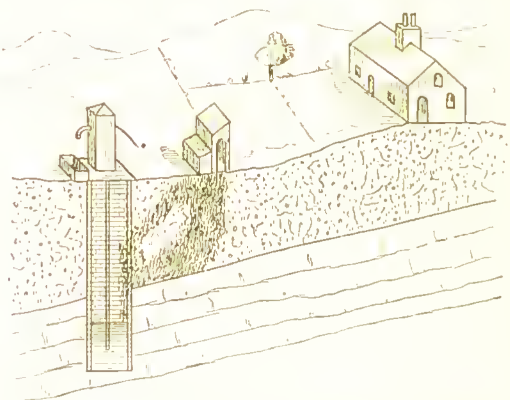


FIG. 14.—Badly-made well polluted with sewage.

very impure, and especially so if drawn from near houses. Marsh and graveyard waters are very bad, from containing much organic impurity.

(*b*) *In Transit from Source to Storage.*—Impurities gathered in transit are especially dangerous and frequent if the water channels are open or are broken, and include washings from cultivated lands, from house drains, from sewers, and from manufactories.

(*c*) *From Storage.*—Impurities may wash off land into large reservoirs or into deep wells. Surface wells are particularly liable to be polluted from the

surrounding soil, and if they are the only source of supply they should be removed as far as possible from all houses, cesspools, manure heaps, piggeries, etc. The bricks of such a well should not be loosely put together, but should be set in cement down to the water line with a layer of puddled clay all round (Fig. 14). Impurities, such as lead or organic matter, may also get into the water from its storage in the house cistern.

(*d*) *In Distribution.*—Impurities may come from the pipes themselves being acted upon and partially dissolved by the water; such is the case with lead, iron, and wooden pipes. This may be avoided by having the pipe lined by some material which is not acted on by the water. If there is a hole in the pipes, sewage or sewage gas from the ground or some neighbouring drain may be sucked in, and so poison the water.

Diseases from Insufficient or Impure Water

1. *Insufficient Supply* causes much dirt and disease. The person and clothes are not properly washed, houses and streets are dirty, and the sewers become clogged with filth. As a result there is a general lower state of health of the community, and typhoid fever and diarrhœa may be prevalent.

2. *Mineral Impurities.*—A moderate degree of hardness is not harmful, but if the hardness is great dyspepsia and constipation may result. Goitre seems to be due to the presence of magnesium limestone in the water, but this is disputed by some. Iron salts cause dyspepsia, constipation, and headache. Lead salts are especially dangerous, causing colic, paralysis,

kidney disease, and sometimes death. These symptoms may occur when the amount of lead does not exceed one-tenth grain per gallon. The purest and most highly oxygenated waters, particularly if they come from marshy ground (as is the case at Sheffield and Bacup), and waters containing organic matter, nitrites, nitrates, and chlorides are those which act most readily on lead pipes and cisterns. Those which act least on lead are the waters containing carbon dioxide, and carbonate and phosphate of lime.

3. *Vegetable Impurities, either in Suspension or Solution.* — Peaty water, in the absence of a better supply, may be used without much harm, but if the amount of solid matter is great it may produce diarrhœa. Under this head we must include water containing germs, for although they generally get into the water from the excretions of animals, yet, as we know, they are vegetable in nature. Here we shall meet with the most dangerous kinds of water, causing many fatal epidemics. (*a*) *Cholera.* One of the most noted outbreaks of this disease occurred in the parish of St. James, Westminster, in 1854, when between 31st August and 8th September 486 fatal cases occurred within a circle of 400 yards' diameter. It was found that all the people affected had been drinking the water from the Broad Street pump, which had a great reputation for purity. This was examined, and it was discovered that the sewage from a neighbouring house in which there were some cases of diarrhœa was running into the well. After the handle had been removed from the pump no further cases occurred. Similarly, the great epidemic at Hamburg in 1892 was due to cholera evacuations

getting into the river Elbe, which supplies the city with water. The constant outbreaks of cholera which occur amongst the Mecca pilgrims every year are due to the fact that they wash in and drink out of the same wells, thus leading to an enormous mortality. (*b*) *Typhoid or enteric fever* is frequently the result of drinking water polluted with stools from other typhoid cases. This was the case at Over Darwen in 1874, when a drain containing the excreta of a typhoid patient was blocked, and its contents got in the main pipe of the water supply. As a result, out of a population of 22,000 there were 2035 cases of typhoid fever and 104 deaths. In Bangor, in 1882, there occurred an epidemic of typhoid fever, affecting 540 persons out of a population of 10,000, of whom 42 died. This was found to be caused by the excreta of a single typhoid patient getting into a small stream which discharged into the river supplying the town with water. (*c*) *Diphtheria* is probably conveyed and caused by impure water, but this is not yet absolutely proved. (*d*) *Dysentery* is well known in tropical countries to be caused by impure water, as was proved by an outbreak at Cape Coast Castle, where it was caused by the passage of sewage into one of the drinking tanks. (*e*) *Diarrhœa* has been caused in epidemic form by impure water, as was shown in the old Salford jail, where the untrapped overflow pipe from a cistern of drinking water communicated with a sewer, and the water had thus absorbed sewer gas, and probably germs. (*f*) *Malaria* may be caused not only by impure air, as has been already mentioned, but also by impure well water in a malarious marshy district. (*g*) *Scarlatina* may possibly be conveyed by water being contaminated with the

scales from the skin, but this is not absolutely proved.

4. *Animal Impurities Proper.*—The eggs and embryos of certain worms and other large parasites may be taken into the system through water, and then develop in the human body, giving rise to various disorders. They are more common in the tropics than in England.

The Purification of Water.—This is performed on a large scale by passing the water through a filter bed made of sand or some similar material, which is regularly renewed. For domestic purposes the best method of purifying water is to boil it for at least ten minutes. This, however, is somewhat troublesome, and also spoils the taste of the water; but if there are good grounds for believing that the water contains germs, it is absolutely necessary. This boiling does not remove such impurities as lead, solid particles, or colouring matter. Another method is to use some form of **domestic filter**, but this is quite unnecessary with very pure water, such as the Glasgow supply. These filters are made of various substances, such as charcoal or silicated charcoal (better in loose pieces than in a compressed block), or spongy iron, which lasts longer. Lately a most excellent filter has been brought forward, which will probably supplant all others, as it

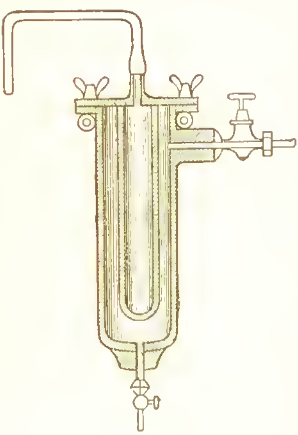


FIG. 15.

absolutely filters away all germs. This is the Chamberland-Pasteur filter, and consists of a tube of the finest biscuit porcelain, through the walls of which the water passes (Fig. 15). No organic substances, such as sponge, flannel, cotton-wool or tow, should be used as filtering materials, as sooner or later they decompose, and add impurities to the water. Filters should not be fixed permanently in cisterns or on the service pipe; they should be so made that they can be easily taken to pieces and regularly cleaned, the method of cleaning varying with the kind of filter.

QUESTIONS

1. Give somes sources of a water supply.
2. What is the difference between hard and soft water, and give the causes of hard water?
3. Give some of the impurities of water and the sources from which they come.
4. What diseases may be caused by impure water?

CHAPTER V

FOOD, COOKING, AND BEVERAGES

Definition and Nature of Food.—Food may be shortly defined as the matter which is needed to enable the body to grow, to be repaired, and to do work. An old and very excellent comparison can be drawn between the body and the steam-engine. The latter is made up of many wonderful mechanisms, but these will remain stationary and not do any work unless provided with fuel and water. When these are supplied in a proper manner work will be performed; and the wear and tear of the engine will in time require to be repaired by various metals. These, together with the fuel and water, may be considered as the food of the engine. Much the same happens with the living body. If a child were not provided with food it would do no work in the form of breathing or moving, it would not grow, and, in fact, all its mechanisms would stand still, and it would soon die. Just as the energy in the coal is converted into force in the steam-engine, and metals are required for its repair, so the energy in food is converted in the body into heat, constructive power,

and motion, and certain parts of the food into new tissue.

Now we shall find a little later that **milk** is a perfect food for children. Let us, therefore, see what it contains. If we allow it to stand for a short time cream forms at the top, and by the process of churning is turned into butter or the **fat** of milk. If we add to the skimmed milk some rennet made from the pig's or sheep's stomach we curdle the milk, and it separates into curds and whey; the curds, being collected and pressed, form cheese, which is the so-called **nitrogenous** part of the milk. The whey which is left consists of **water**, in which are dissolved a peculiar kind of **sugar**, called milk sugar, and certain **salts**, such as phosphate of lime and potash, chloride of sodium, and several others. We thus see that in this perfect food, milk, we find nitrogenous, sugary, and fatty bodies with salts and water. It has, indeed, been found by many experiments that we cannot live on a diet which does not include all these constituents, which we will now study separately.

Nitrogenous Bodies

(*a*) **Nature.**—These consist of substances which are all composed of certain proportions of carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus. They are represented in animal food by the curd (cheese or casein) in milk, by the albumen in white of egg, serum albumen and fibrine in blood, syntonin in muscle; in vegetable food by the gluten of flour and the legumin of the pea and bean tribe. Gelatine is allied to these, but cannot replace them in a dietary.

(*b*) **Function.**—It used to be supposed that these nitrogenous bodies were converted in the body directly into muscle or flesh, and that when the muscles acted and work was done the muscle wasted and was used up. This is now known to be incorrect, and it is supposed that they are the bodies which form and construct the body, and enable it to grow and to be repaired; that also they regulate the absorption and use of oxygen in the body, and may occasionally form fat.

Fatty Constituents

(*a*) **Nature.**—These are the hydrocarbons, made up of carbon, hydrogen, and oxygen, the oxygen being insufficient in amount to convert all the hydrogen into water. They are represented by the various well-known forms of fat in the animal world, such as butter, oil, suet, dripping, lard; and in the vegetable world by olive oil, the oil of seeds and nuts, etc.

(*b*) **Function.**—By their destruction in the body they contribute very largely to the animal heat, their power in this way being more than twice as great as that of the next group. They also supply a certain amount of the energy of the body, and help to increase the amount of fat deposited in the body.

Sugary and Starchy Constituents

(*a*) **Nature.**—These are of the same class, for the starches are converted into sugars before they are absorbed. They are known under the common

name of carbohydrates, being composed of carbon, hydrogen, and oxygen, the last two being present in the exact proportions necessary to form water. They are found almost entirely in the vegetable world, and comprise the various forms of starch and sugar, such as potato starch, wheat starch, cane sugar, grape sugar, beet sugar. In the animal world we have milk sugar in milk.

(*b*) **Function.**—The carbohydrates are probably the great producers of energy and heat in the body, and are also converted into fat, which is a store of energy for future use.

Salts

(*a*) **Nature.**—These comprise chlorides of sodium and potassium, phosphates of potassium, calcium, and magnesium, various salts of iron, etc.

(*b*) **Function.**—The salts build up and support the skeleton, supply the necessary acids and salts for the digestive juices, and assist very largely in the absorption and utilisation of other foods in the body. Some of them are indispensable constituents of the body, such as the iron in the blood and phosphorus in nervous tissue.

Water

This is absolutely necessary, as before pointed out. It assists in the solution and absorption of the food, forms about 70 per cent of the animal tissues, and gets rid of much of the waste matter of the body by the urine and sweat, and assists in keeping the body at a uniform temperature by evaporation.

About five pints of water are given off from the body by the lungs, skin, and kidneys in twenty-four hours.

Proper Proportion of Various Constituents.—It has been found by numerous experiments that a perfect diet necessary for an ordinary man doing moderate work must contain each day 300 grains of nitrogen and 5000 grains of carbon; moreover, that the proportion must be 5 ozs. of nitrogenous food, 15 ozs. of carbohydrates (starches and sugars), 3 ozs. of fat, and 1 oz. of salts. This is equal to 24 ozs. of dry food per day, but as food contains half its weight of water, we must allow 48 ozs. of real food per day. By using these numbers, and comparing them with tables showing the amounts of each constituent in certain kinds of food, a good dietary may be constructed; and it is essential that the proportion above given should be used, or disease and starvation may result. We shall shortly show how by experience man has selected a diet which contains these elements in about the right proportion.

Study of Various Foods

We must now examine some of the most important foods, and see what they are composed of.

Milk.—This has already been partly studied. If pure, it should be perfectly opaque, white in colour, free from deposit, give about one-tenth of cream on standing, and should not alter on boiling. Cow's milk contains in 100 parts—W, 86·8; N, 4; F, 3·7; C, 4·8; S, ·7.[1] Human milk contains—W, 90;

[1] To save repetition in the analyses given below, W stands for water, N for nitrogenous, F for fatty, C for sugary and starchy, and S for salty constituents.

N, 1; F, 4·3; C, 7·6; S, ·2; it clots or curdles in the stomach in small separated particles, and not in large lumps, as cow's milk does, a fact of great importance to the child. Although milk is a perfect food for a child, it is not quite so for an adult, as one pint only contains $2\frac{1}{2}$ ozs. of water-free food, and so, in order to get 24 ozs. water-free food per day, a man living entirely on milk would have to drink over 9 pints of it, which would contain too much water, nitrogen, and fat. If, however, mixed with a certain amount of sugar, it would be a good diet for an adult. Milk may be preserved by boiling, and then corking tightly in a bottle, with a little sugar added; or by adding a few grains of sugar and bicarbonate of soda to each pint, or a few grains of boracic acid.

Butter.—This is almost a pure fat, containing—W, 11; N, ·5; F, 87; C, ·5. It is obtained by churning pure milk or cream so that the little masses of fat run together. When this is separated buttermilk is left, which, when used with some starchy food, such as potatoes, forms a good diet.

Cheese is made by adding rennet to milk, which causes it to curdle. These curds entangle many of the fat globules. It contains almost all the nitrogenous part of the milk, its average composition being—W, 36; N, 33; F, 24; S, 5. You see it is a very nitrogenous food, containing, in fact, twice as much nitrogen as beef, and if rich and crumbly, is easily digested. Poor cheeses, such as Dutch and American, are made from skimmed milk; rich cheeses, such as Cheshire or Stilton, from pure milk, or even milk to which cream has been added, so as to increase the amount of fat.

Eggs used for food are generally hens' eggs, but

duck, goose, and turkey eggs may be eaten. An average-sized hen's egg weighs 2 ozs., of which 200 grains are solid matter, consisting of nitrogen matter, 110 grains; fatty, 82 grains; salty, 11 grains, and merely a trace of grape sugar. Fresh eggs are more transparent in the centre, old eggs at the top. If we make a solution of 1 oz. of salt to 10 ozs. (about half a pint) of water, and put an egg in, a good egg will sink, an indifferent one will swim, while bad eggs will float in pure water. Eggs may be preserved by keeping air from passing through the porous shell by packing in sawdust or salt, or covering the shell with gum, wax, or a solution of lime. Frequently changing their position is good, as it keeps the yolk from sticking to the shell, and so being near the air.

The Flesh of Animals as Food.—The flesh of animals contains a large amount of nitrogenous and fatty matters and many important salts, but practically no carbohydrates. It is more easily cooked and digested than most vegetable foods. As a sample of its composition we may take the flesh of the **ox**, fat beef containing—W, 51; N, 14; F, 29; S, 4; and lean—W, 72; N, 19; F, 3; S, 5. The flesh of animals hardens or sets in what is called *rigor mortis* soon after the animal is killed, and if eaten in this state would be very tough. In from one to six days, according to the animal and the weather, this passes off, and the meat again becomes tender and pleasant to eat. It is for this reason that meat is "hung" before eating. The flesh of young animals is less digestible than that of old, veal less than beef, and lamb than mutton.

The best **beef** is that cut from a four-year-old animal, the best part being the rump, and then the

sirloin, fore ribs, buttock, middle rib, flank, shoulder, brisket, cheek, neck, and shin, in this order.

Mutton has a shorter fibre, and is more easy to digest than beef. That from a three-year-old sheep is the best. Hot mutton fat is often not easy to digest unless minced finely with potatoes. The most choice piece is the leg, then the saddle, loin, and shoulder. **Venison**, or the flesh of deer, must be hung some time before eating, or it is tasteless and tough. **Pork**, or the flesh of the pig, is often very fat, and not easy to digest. **Bacon** is, as a rule, much more digestible, and is an excellent fatty food, children often taking it when other forms of fat are refused.

The bones of animals broken up and boiled for some time yield **soup**, which, in spite of many opinions to the contrary, is a nourishing and sustaining food, especially when eaten with bread. The liver, kidneys, pancreas (sweetbread), and heart of animals are also useful as food.

Poultry and game possess very little fat, have a short-fibred meat, and, as a rule, are very digestible, especially fowls, turkeys, pheasants, and partridges; but ducks and geese are more fatty, and do not agree with many people. Game has less fat and a finer flavour than poultry. Hares and young rabbits yield good food.

Fish is, as a rule, a delicate and easily digestible food. There are three varieties—one with white flesh, such as whiting, sole, turbot, brill, cod, plaice, etc., containing little fat; red flesh, as salmon, not quite so digestible as the first class; and the greasy flesh, such as pilchard, sprats, mackerel, herring, and eels, with much fat, and often difficult to digest. It

is doubtful if fish is a true brain food. An analysis of these varieties is as follows :—

	W	N	F
Sole .	86	12	0·25
Salmon .	74	15	6
Herring .	81	10	7
Eel .	57	13	28

Shell-fish, such as lobster, crab, crayfish, shrimps, and prawns, are very nutritious, but very indigestible. Amongst the mollusca, oysters eaten raw (not cooked) are very nutritious and digestible, ten oysters being sufficient to supply the necessary daily amount of nitrogenous food. Mussels and cockles are similarly good, though occasionally they produce poisonous symptoms.

Vegetable Foods

These all contain nitrogenous, starchy, sugary, and fatty bodies in certain quantities, but the starchy and sugary are much in excess of the other two. Thus to take wheat as an example, we find it to contain W, 14; N, 12; F, 1; C, 70; S, 1. Vegetable food is, however, less digestible on the whole, and less capable of complete change in the body than animal food. The nitrogenous materials are either in the form of vegetable albumen, legumin, or gluten, the composition of these being very similar to that of animal albumens. The carbohydrates are in the form of starches, cellulose, and sugars, and the fats in the form of various vegetable oils. There are six great classes of vegetables—(*a*) Farinaceous seeds

from the grass tribe, or cereals, as they are called; (*b*) leguminous or pulses; (*c*) roots or tubers; (*d*) green vegetables; (*e*) fruits; (*f*) edible fungi.

(*a*) The *cereals* include wheat, barley, oats, rye, maize, and rice. These are the best vegetable foods, are very nutritious, easily carried, and keep well. They contain N 5 to 14, C 68 to 76 per cent, and much mineral matter, such as phosphates, lime, magnesia, potash, soda, iron, and silica. These seeds are ground down to meal, and the outside, hard, indigestible woody fibre is thus separated. Too much of the outside shell should not, however, be removed, as it contains most of the nitrogenous gluten; thus what is called whole wheat meal is more nutritious than white flour, but much bran should not be mixed with the flour, as it often irritates the stomach and intestines. Oats are very rich in fats and mineral matters, and maize especially in fats, rice containing large amounts of starch. Bread can be made from wheat or barley (if mixed with wheat), from rye (forming a dark brown bread, which easily turns sour), but not from oats, as it contains but little gluten. The last is principally used in the form of oatmeal.

(*b*) *Pulses* include peas, beans, lentils, etc., which contain much nitrogenous matter, and can thus replace animal diet to a large extent. Peas contain W, 14; N, 23; F, 1·5; C, 53. Lentils are the most nutritious of the pulses, containing much nitrogen and a good deal of iron. Lentil meal makes an excellent soup, much better than pea soup.

(*c*) *Roots and tubers*, as potatoes, artichokes, arrowroot, tapioca, sago, carrots, parsnips, turnip, and beetroot, contain much starch and water and little nitrogen. For example, potatoes contain W, 76; N, 2;

F, 2; C, 20. Carrots and beetroot also contain much sugar.

(*d*) *Green vegetables*, such as cabbage, cauliflower, vegetable marrow, tomatoes (both fruits botanically), lettuce, onion, etc., are not very nutritious, but contain many valuable salts, and give a necessary variety and relish to food. They contain little or no starch, the carbohydrates being in the form of cellulose and other matters (chlorophyll).

(*e*) *Fruits*, such as apples, oranges, grapes, strawberries, and figs, are particularly rich in potash salts. They have a low nutritive power, for although they contain much sugar, they also contain a large amount of water and little nitrogen. They are useful as a mild and pleasant purgative.

(*f*) *Edible fungi*, as mushrooms, contain much water (91 per cent) and a little nitrogen, but are often not easy to digest.

Saccharine substances are found in certain substances besides those mentioned, and are extracted from them to be used as foods. Thus we have cane sugar, treacle, and molasses from the sugar cane, beet sugar from beetroot, maple sugar from the maple, and honey from bees. Grape sugar is not much used separately as a food.

Condiments or flavourings, such as salt, pepper, mustard, vinegar, herbs, and spices, are not in any sense true foods, but are very useful, as they assist in making food more palatable, improve the appetite, and stimulate the various digestive juices to flow.

The Construction of Dietaries.—I showed at the beginning of the chapter what the primary elements of food were, and what proportion of them must be taken in order that health should be main-

tained. If we examine the composition of all the various foods I have mentioned, we shall see that milk is the only perfect food, and even that alone does not quite satisfy the requirements of an adult. We must therefore select a mixed diet. If we attempt to live on beef alone we get too much nitrogenous matter and fat, and no carbohydrates; if on bread alone, too much carbohydrate, too little nitrogenous matter, and no fat, and so on. As a matter of fact, however, people have by experience chosen a mixed diet which contains the various elements in about the right proportion. Thus we eat bread and cheese, beef and potatoes, oatmeal porridge and milk (Scotch), butter milk and potatoes (Irish), veal or chicken with bacon and bread or potatoes, milk with rice or tapioca in the form of milk puddings, and so on. Although most of us choose that we should eat our nitrogenous matter in the form of animal food, as being more palatable, more easily cooked, and more digestible than vegetable food, yet it must be remembered that we can get the required quantity of nitrogen from the vegetable world alone by using vegetables rich in this substance, such as the pulse family, as is done by certain people who call themselves "vegetarians." Perhaps, on the whole, the value of vegetable food is too much neglected by poor people, for it is not only nutritious, but it is cheap. As Parkes says: "The labouring man, by ringing the changes on oatmeal, maize, peas and beans, rice and macaroni, to which may be occasionally added cheese and bacon, may bring up his children as well nourished as those of the richest people, and at a small cost. Oatmeal, the most nutritious of the cereal grains, and formerly the staple food of our

finest men, Indian meal, peas, and beans, and rice are far less used by our poorer classes than should be the case."

Variety in food is very necessary, as sameness spoils the appetite, whereas variety improves it. Even if there is not a variety of food there should be a variety of cooking the same food. One soon gets tired of cold mutton each day for dinner, but if the cold mutton be made into mince one day, a curry the next, and "shepherd's pie" a third day, the joint may be finished without disgust.

As regards **the price of food**, the following table, drawn up by Frankland, shows a list of various foods which, when eaten, are capable of enabling the person to perform the same amount of work :—

	lbs.	Price per lb.	Cost.
Bread . . .	2·345	1½d.	3½d.
Oatmeal . .	1·281	2¾d.	3½d.
Potatoes . .	5·068	1d.	5¼d.
Beef fat . .	0·555	10d.	5¼d.
Cheese . .	1·156	10d.	11½d.
Butter . .	0·693	1/6	1 0½d.
Lean beef . .	3·532	1/	3/6½d.
Pale ale . .	9 bottles	6d. per bottle	4/6

Arrangement of Meals.—Meals should be taken at definite times of the day, so arranged as to prepare the body for work, and to stimulate the body after work has been done. In health they should be taken not more frequently than three, or, at most, four times a day, at intervals of about three or four hours, and no food should be taken between

these regular meals. Work should not be resumed immediately after a meal, as a short rest is necessary to assist digestion, and the food must be eaten slowly and deliberately, and should be thoroughly masticated or finely divided by the teeth. In order to stimulate the organs of the body (which are always somewhat feeble and in a more or less sleepy state in the morning) and to prepare them for the day's work, a substantial **breakfast** should be taken, consisting of some fluid, such as coffee, cocoa, milk, or tea, with bread and butter, eggs, or bacon, or meat. Oatmeal porridge, or marmalade, or a few figs are excellent with breakfast, to assist the action of the bowels. At a time varying from twelve to two o'clock, according to the time at which breakfast was taken, another meal, **dinner**, is necessary. This, as a rule, should again be substantial, especially if the work is muscular labour, and should consist of meat, vegetables, bread, or pudding. The third meal, **tea**, should be a light one, consisting of tea and bread and butter, just enough to sustain the body between the long interval of dinner and supper. The last meal, **supper**, should not be too heavy, and not too late (say about nine o'clock), or it will interfere with sleep. It may consist of milk or cocoa, bread and butter, and eggs, a little meat or cheese, if it does not cause indigestion. This system of feeding is very suitable for men and women doing muscular work, and has been exemplified by Wilson in the following table:—

Breakfast: Milk, $\frac{3}{4}$ pint; water, $\frac{1}{4}$ pint, with coffee or tea; bread, 4 to 6 ozs.; butter, $\frac{3}{4}$ oz.; sugar, $\frac{3}{4}$ oz.; bacon, 3 ozs.; or two eggs or cooked meat, 3 ozs.

Dinner: Soup, 6 ozs.; cooked meat, 1 to 6 ozs.;

potatoes, 8 ozs.; bread, 3 to 4 ozs.; pudding, 8 ozs.; cheese, $\frac{1}{2}$ oz.; water, $\frac{1}{2}$ pint.

Tea: Water, with tea, $\frac{3}{4}$ pint; sugar, $\frac{3}{4}$ oz.; milk or cream, 2 ozs.; bread, 3 ozs.; butter, $\frac{1}{2}$ oz.

Supper: Milk, $\frac{3}{4}$ pint; oatmeal, 1 oz.; bread, 3 ozs.; or 2 eggs or cooked meat, 3 ozs.; and bread, 3 ozs.; butter or cheese, $\frac{1}{2}$ oz.; water, $\frac{1}{2}$ pint.

Adaptation of Food to Varying Circumstances

Although the above is a good diet, yet it has to be changed according to circumstances.

Age.—The diet of infants will be specially considered later. After weaning the diet should consist principally of milk, to which corn-flour or other carbohydrates may be added. Gradually bread crumbs and gravy, eggs and milk puddings may be allowed, and as the child gets older, fish, meat, and soups with vegetables may be given. The meals should be small in quantity, but more frequently given than in the case of an adult. At ten years of age children require half as much food as a woman, and at fourteen quite as much; young men doing the same work as adults require more food, as they are in a growing condition. Old people have feeble digestions, and should therefore have easily digested food given often in small quantities, and taken warm.

Climate.—In cold and temperate climates more animal and fatty food can be taken than in hot countries, as more exercise is taken, and animal food is needed to rapidly repair the body, and the fatty food to increase the heat. In hot countries light, easily digested, and less heating foods, such as rice

and sugars, are better than large quantities of animal foods.

Employment. — Routine hard work requires twice as much food as idleness. Outdoor workers have a vigorous digestion and a good appetite, and so a large quantity of food can be consumed, and a considerable part of the nitrogenous matter may be drawn from the pulse tribe, and substances like cheese and bread, green vegetables, bacon, oatmeal, etc., are easily digested. Those engaged in indoor work, on the contrary, have poor appetites and digestions, and so must have very digestible food in small bulk, such as animal food, very digestible forms of fat, bread, and well-cooked porridge and milk. If a person is engaged in hard mental work in the afternoon, a very light lunch only should be taken, about four o'clock some tea and a little bread and butter, and about seven a substantial dinner; a rest for an hour after this will enable the person to do more work before going to bed. If the mental work is more at night time, a mid-day dinner should be taken and only a light supper.

The Feeding of Infants.—Until an infant is eight months old it should only be fed on human milk, or, if this is impossible, on specially prepared cow's milk, although this is not so good; no starchy food whatever should be given. The reason of this is, that for about six months after birth the saliva and the pancreatic juice will not digest starch. During the first two months the child should be put to the breast every two hours, from 5 A.M. to 11 P.M.; then to the end of the third month every three hours; from the fourth to the eighth month every four hours. If the mother and child are doing well, the latter

may be "weaned" about the ninth month. Now some other food may be given with the milk, such as Benger's, Mellin's, or Nestlé's foods, mutton broth or chicken jelly, custard puddings or a little soft bread; but cow's milk should be the principal article of diet, after being boiled and mixed as follows: milk, 8 tablespoonfuls; cream, 1 tablespoonful; water, 3 tablespoonfuls; and sugar, 1 teaspoonful. After eighteen months of age, a little chicken, mutton, beef and mutton fat mashed up with potatoes may be given. If there is no human milk forthcoming for an infant, an **artificial human milk** may be made as follows: Take the cream from $\frac{1}{3}$ of a pint of milk; add this to $\frac{2}{3}$ of a pint of pure milk. Put a small quantity of rennet powder or liquid (obtained from the grocer) in the $\frac{1}{3}$ pint of skimmed milk, and warm at the temperature of the body for fifteen minutes; this will curdle the skimmed milk; break up the curd and boil for a minute or two, and filter through fine muslin, so as to separate the curds from the whey. Dissolve about a teaspoonful of sugar in the whey, and add the sugared whey to the $\frac{2}{3}$ pint of milk and cream. This looks very difficult, but it is quite easy if once tried. Half a pint of cow's milk prepared as above may be given daily until the child is two or three weeks old, 1 pint until it is twelve weeks old, and 2 pints at six months old. The only proper feeding bottle for an infant is what is called a lamb-feeder (Fig. 16), which can be very easily cleaned, and has no objectionable tubing of glass or india-rubber, which

FIG. 16.

can never be cleaned, and, as a result, rapidly turns milk sour, and makes the child ill. The lamb-feeder must be thoroughly cleaned with hot water after each time it has been used, and a new teat put on frequently. If good cow's milk cannot be obtained, then condensed milk of some good brand, such as the "Milkmaid" brand of the Anglo-Swiss Milk Co., should be used. It is mixed with 16 parts of water for infants of one month old, and gradually less water is added until the strength is 1 of condensed milk to 7 of water when the child is eight or ten months old; the total amount of the mixed milk and water during the day also varying from 12 ozs. during the first week to about 2 pints daily at three months of age. When we remember the numbers of children who are killed every year from bad feeding, the enormous importance of the above remarks will, I hope, be appreciated.

Diet in Sickness.—In sickness the digestive powers are very weak, and the body needs sustaining, so the food must be given frequently in small quantities, and must be of an easily digestible kind. Thus in fevers liquid food, such as milk, soups, beef-tea, beaten-up eggs, with cooling drinks, such as whey, barley-water, or soda-water, should be given. As the fever subsides milk puddings, bread, jelly, boiled white fish, lightly-boiled eggs, and chicken may be eaten. In rheumatism no animal foods must be given, but beef-tea does not seem to do harm. In diarrhœa milk and rice are best; the food should be given cold, or only slightly warmed, and no fruit or vegetables or solid food should be taken. For constipation oatmeal porridge, brown bread, vegetables, and fruits, such as apples, prunes, and

figs, with marmalade for breakfast, are useful. In dyspepsia, especially accompanied with flatulence, such vegetables as peas, cabbage, and beans, fat and salty and greasy foods should be avoided. Milk may be found to disagree with some stomachs; if so, it may be mixed with a little warm water.

Cooking

Cooking is a process through which nearly all food used by civilised man has to pass before it is fit for consumption, very few articles indeed being consumed in their natural condition, the exceptions being milk, eggs, oysters, some vegetables, and fruit. By means of cooking food is partially broken up, so that it is more easily masticated and acted upon by the digestive juices. Moreover, cooking develops agreeable flavours which stimulate the appetite and the flow of the digestive juices, the warmth of cooked food having a similar action. Another important use of cooking is that it kills any parasites or eggs which may be in the food. Mere cooking is not enough, but good cooking is essential, for to cook food badly is often to make it more indigestible than before, and even to make it unfit to eat. Moreover, no one but a good cook can utilise food to the full extent without waste, and present it in such a pleasing and palatable form as to stimulate the appetite of the weary town dweller. To be a good cook should therefore be the great ambition of every housewife. I cannot, of course, here give a full account of cooking, but shall only point out a few of the common processes used.

Cooking Animal Food

Boiling.—Of this there are two methods. If it is desired to keep all the nutritious matter in the meat, it must be put into boiling water for about five minutes, in order to coagulate the albumen on the outside, and so form a sort of hard case which will keep in the meat juices. The process must then be finished at a temperature of 170° Fahr. (much below boiling point) by drawing the pan a little away from the fire. If it is kept boiling the whole time, the meat will be hard and indigestible. If, on the contrary, it is desired to make broth or soup, the meat should be cut into small pieces and put into cold water, and the temperature gradually raised to 170° Fahr., and no higher; but if it is required to extract the gelatine from the bones or meat, then boil for some little time. Chicken makes the strongest broth, then mutton and beef.

Roasting.—This method retains the nutritious juices better than boiling, and at the same time develops an agreeable flavour and taste. The joint should be first exposed to a great heat for a short time to coagulate the outside; then it should be drawn away from the fire, and the process completed at a lower temperature. A certain amount of juice and fat in the form of gravy will run away. To prevent the meat from scorching, and the surface from becoming hard, it should be repeatedly "basted" with fat. The loss during roasting is about the same as from boiling.

Baking is a very similar process to roasting, but is conducted in a closed oven, which must be properly ventilated. The loss by this method is less than by

roasting, and the meat has a strong rich flavour, but is not so digestible.

Stewing is a very economical method, as all parts of the meat are used. The meat is also well loosened, and so is easily digested. The meat is cut into small pieces, and just enough cold water is added to cover it. It is then allowed to simmer gently, but not to boil. Vegetables are often mixed with the water, which thus becomes a rich thick gravy. If the fluid is too greasy, some of the fat may be skimmed off.

Grilling or broiling is the same as roasting on a small scale, but is more rapid. It is performed on a gridiron, and brings out the flavour of the meat well.

Frying is done in a frying pan by putting the meat in boiling oil or fat, and, as a result, fried meats often disagree. The method is often used for fish, but boiled fish is more digestible.

Cooking Vegetable Foods.—Many vegetables, especially the grains and those containing much starch, are uneatable unless cooked. By cooking, the vegetable cell-walls are ruptured, and the starch granules burst, so that the digestive juices can act on them. Many of the grains are made into **bread** by first grinding them into flour, and then mixing them with water to form a dough, which is well kneaded. This dough is made air-containing or porous by developing carbon dioxide gas in it, either by fermentation by yeast, or by forcing the gas in directly, as in the so-called "aerated" bread. The mass is afterwards baked. It is doubtful if brown, or, as it is sometimes called, digestive bread is more wholesome than white bread. In fact, many say that it is less so, as the particles of the skin of the wheat grain irritate the stomach.

Macaroni is formed from flour, and is composed very largely of the gluten, and is thus a highly nitrogenous and nutritious article of food, is easily and rapidly digested, and is a cheap and excellent substitute for beef or mutton. Rice, potatoes, and other foods rich in starches must be well boiled.

The Preservation of Food. — To prevent germs growing in food and causing putrefaction only such methods can be used as will not affect the wholesomeness of the food itself. We may for this purpose totally exclude all air, as is done with tinned foods, where the air is driven out by heat, and the tin then tightly sealed. Or the food may be dried, as is done with dried fruits, such as raisins. Sometimes a chemical, such as alcohol or vinegar, is used, or tarry products, as in the case of smoked bacon, or brine, as in salted foods. Boracic acid is occasionally dusted on food in hot weather, and prevents it being "tainted." Great cold is probably the method most used, and by this means large quantities of fresh meat are brought from distant countries in the frozen state, such meat being good and cheap.

Diseases due to Food.—These diseases may be divided into several classes: 1. *Those due to Bad Dieting or Cooking, the Food itself being good.*

(*a*) *Excess of Food.*—If food is taken in too great a quantity, it is not absorbed, and may become putrid in the intestines, and cause dyspepsia, constipation, or diarrhœa. If the excess is principally in the nitrogenous materials, it leads to increase of the chemical changes in the body, and the person tends to become thin rather than otherwise. It may cause gouty conditions and diseases of the kidneys

and blood-vessels. Excess of starchy and sugary foods often causes acidity and flatulence and great fattiness of the body, as is also the case with excess of fatty food.

(*b*) *Deficiency of Food* produces gradual loss of flesh and weakness of all the bodily organs, particularly of the heart. The body is, moreover, little able to resist cold and various diseases, and thus half-starved people are easily attacked by fevers and consumption.

(*c*) *Bad Proportion of Food Stuffs and Bad Arrangement of Meals.*—If food is not given in about the right proportions, various dyspeptic troubles may arise, and the body will not be properly nourished. Similarly, eating food in a hurry, bad cooking of food, and a bad arrangement of meals, the food being taken too often or too seldom, or too much taken at one time and too little at another, will lead to stomach troubles. One of the best-known diseases caused by the absence of some essential of a diet is called **scurvy**. This used to be very common on board ships on long voyages, but whether it was caused by the great use of salt beef, or (more probably) by the absence of fresh vegetables, is not known. Nowadays fresh meat can be more easily taken on long voyages, and potatoes and lime juice are freely given, so that sea scurvy is practically unknown. In large towns, however, we very frequently see the same disease, as shown by the sore and bleeding gums and the appearance of blood under the skin like small bruises, and the condition is only found in badly-fed people, who will tell you that they live almost entirely on bread and butter and tea, with meat occasionally, and fresh vegetables

sometimes on Sunday. This land scurvy soon disappears when proper food is given.

Rickets is a disease found in young children, and is very largely due to feeding with improper food, (such as starchy materials), and to an absence of fresh air. The child perspires chiefly about the head at night, and the whole body seems to be tender and sore, the ends of the bones becoming soft and enlarged, especially near the ankles and wrists, and deformities of the limbs, such as bow legs or knock knees, may result. If there is any sign of this disease beginning, the child must not on any account be allowed to walk for many months, and he should be given plenty of fresh air, sunlight, and good nourishing food.

(*d*) *Idiosyncrasy.* — This term is applied to personal peculiarities. Some people cannot eat certain foods without being ill. Flat-fish, such as soles, cause some to vomit; eggs cause indigestion with others, and shell-fish sometimes causes nettle rash.

2. *Diseases due to Food originally good, but eaten when it has become putrid.*—It is a curious fact which we cannot explain that some food, such as ripe cheese, game, and "high" mutton, is only eaten in a state of decomposition, and yet no evil results follow. Apart from these examples, we know that putrid food ought to be absolutely avoided, as it may cause intense poisoning, with vomiting, diarrhœa, great collapse, and even death. Such cases are, unfortunately, not uncommon from the eating of putrid meat pies, hams, and sausages.

3. *Food diseased in Itself.*—Diseased animals not unfrequently communicate their diseases to man. Thus so-called "measly" cattle and pigs contain in

the flesh or muscles innumerable small bladders, which are living animals of a low type. When these are taken into the intestines of man without being killed by thorough cooking they begin to grow, and form tape-worms. Another disease found hardly ever in England, but more often in Germany, Russia, and Sweden, is trichinosis, which is caused by eating pork either raw or not properly cooked. These animals consist of minute worms which live in the muscles of the pig, and which, on getting into the intestines of man, begin to breed in enormous numbers; the young worms then pierce the intestines, get into the blood-vessels and into the muscles, so causing diarrhœa, fever, pains in the muscles, and even death. Certain diseases in cattle ought certainly to prevent them being used as food; these are infectious inflammation of the lungs of cattle, cattle plague, and consumption in the cow, smallpox in the sheep, and trichinosis and swine fever in the pig. The milk also of cows affected with foot and mouth disease sometimes causes severe symptoms with very sore mouth and lips and, rarely, sore hands in children, and it is almost certain that the milk of tubercular (consumptive) cattle will cause consumption in the human being.

Vegetable foods, if putrid and decayed, may cause severe illness, just as may happen with putrid animal food.

4. *Good Food conveying Germs.*—This is most frequent in the case of milk, where it has been found that whole districts supplied by one milk farm have been affected with some disease, such as typhoid fever, diphtheria, or scarlet fever, and inquiries have shown that either at the farm or in the milk shop

germs of these diseases have got into the milk, either from the air, from sewer gas, or more often from water taken from an impure source, and either added to the milk as an adulteration, or used for washing out the milk cans. These diseases carried by milk, as well as tuberculosis from the milk of tuberculous cows, can be entirely prevented by boiling the milk for at least five minutes before it is used.

Beverages

As we have already said, water in some form is an absolute essential in the food of man, and he requires from $2\frac{1}{2}$ to 4 pints a day, according to his work, the dryness of his food, and the weather. Water is, of course, contained to a large extent in all other beverages, and these are more often taken as being more pleasant than water alone. Though milk is an excellent beverage, we shall not further consider it in this place. The other common beverages used are tea, coffee, cocoa, and alcohol in some form. All these beverages are stimulants in either slight or great degree.

Tea contains a stimulant called theine, tannic acid, and many other bodies. China and India teas are most used, the former being by far the best, as it contains less tannin, and long brewing does not greatly increase the amount of tannin, the reverse being the case with Indian teas, which cause more digestive and nervous troubles. Tea should not be boiled, and should not be infused for longer than three or four minutes. If it has to stand longer than this the infusion should be poured off from the leaves and put into another tea-pot. It is an excellent restora-

tive to the nervous and muscular system, and diminishes the desire for sleep and food. When taken with milk and sugar a cup of tea contains much nutriment. It has been found of great service for soldiers on active service, being infinitely superior for them than alcohol. If it is taken in excess it causes dyspepsia, nervousness, and palpitation; it interferes with the digestion of starch by saliva, but not if about 10 grains of bicarbonate of soda are mixed with each ounce of tea.

Coffee contains a stimulant called caffeine (which is very similar to theine), a little tannin, and certain aromatic oils. It should be freshly roasted and ground if the full flavour is desired. It may be made either by boiling for a very short time, or by merely infusing with boiling water. It stimulates the heart and nervous system, lessens fatigue and the desire for sleep, and acts with many as a gentle purgative; taken with milk and sugar it is a food. If taken in excess it acts injuriously on the heart and nerves; it retards stomach digestion, so strong coffee should not be taken after dinner by people with weak digestions. Chicory is often added to coffee as an adulteration, although many people prefer a little to improve the taste and colour of the coffee.

Cocoa is generally sold either in the form of cocoa itself or chocolate. It is a slight stimulant, owing to the presence of theobromine, allied to theine and caffeine; it also contains fat, sugar, and nitrogenous bodies, so it is almost a perfect food. Pure cocoa, however, contains too much fat, and may disagree, and chocolate often contains too much starch or sugar, but less fat. If taken with milk it is a very good and nutritious food.

Alcohol.—This is contained in all intoxicating liquors, whether cider, beer, wine, or spirits, the proportion of pure alcohol being 40 per cent in spirits, 22 per cent in sherry, 10 per cent in claret, 5 per cent in English beer, 3 per cent in German beer. A certain amount of the alcohol taken is probably used up in the body as a food, lessening the oxidation and waste. Small doses are a stimulant to all the organs of the body, larger doses are a sedative, and larger doses still a dangerous narcotic poison like opium. These effects are seen in the various stages of drunkenness—the excitement, the sleep, the "dead drunk" stage, and even death. Alcohol is not required by the body, and, as a rule, to which there are few exceptions, people are much better and healthier without it; for instance, it has been repeatedly proved that soldiers can bear the hard labour of war very much better when no alcohol is given to them. In large and repeated quantities it causes many diseases, such as gout, diseases of the liver, heart, brain, and nerves; besides this, its use brings about an infinite amount of suffering by wasting the money of the people, money which should be spent in a better manner by giving them healthy and clean homes and good food and clothing. About three-quarters of the people in work-houses are there, directly or indirectly, from the abuse of alcohol; about half the crime in the country is caused by it, and about one quarter of the insanity. Thus it can be seen to be one of the most harmful poisons on earth. To some people, dwellers in towns, with hard mental work to perform, it is, however, almost a necessity, but even they should not take more than two ounces of pure

alcohol a day, an amount which is contained in two pints of beer, or in half a pint of claret, or in four ounces of spirits. Alcohol should never be taken between meals, but only with food; it should never be given to children except when ordered by a doctor, and should never be taken by those who have insanity or drunkenness in their families. In the treatment of disease it is a most useful drug, but here again only to be used by a doctor's order.

QUESTIONS

1. How would you define "food"?
2. What are the proper constituents of food, and what are their functions?
3. What are the correct proportions of the various constituents of food in a good diet?
4. Of what is milk composed?
5. Give some examples of simple meals containing all the constituents of food in about the right proportion.
6. What is the correct method of feeding infants?
7. Why should most food be cooked before it is eaten?
8. What diseases may be caused by bad food and feeding?
9. What are the evil effects caused by taking too much alcohol?

CHAPTER VI

PERSONAL HEALTH

ALTHOUGH air, water, and food of pure quality and sufficient quantity are so necessary for the preservation of health, yet there are certain other necessities which depend on the individual, and these we shall consider under the title of personal health, and shall include hereditary disease, cleanliness, habits and occupation, exercise and rest, and clothing.

Hereditary Disease.—The tendency, or, as it is called, the predisposition to certain diseases, is unfortunately handed down from parents to children. It must be understood that, as a rule, it is not the disease itself which is thus transmitted, but only the tendency to it, so that such a person's body is unable to resist a certain disease when attacked by it. The most common hereditary diseases are the mental and nervous, such as insanity and epilepsy (in which the tendency is very great), rheumatic affections, gout, chest affections (such as bronchitis and asthma), consumption, probably cancer, and some others. Now when such a tendency exists the greatest care should be taken from the earliest age to so bring up a child that it will be able to overcome its hereditary taint.

Thus with insanity in a family, the children should not be encouraged to exhibit any unnatural cleverness, should have more than the usual amount of bodily exercise as compared with exercise of the brain. They should not be allowed to dwell too closely on religious subjects, and should be made as far as possible to live outside themselves, as it were, paying more attention to the natural objects around them than to their own condition and their own thoughts. If there is a tendency to consumption they should have an abundance of fresh air and exercise, and be encouraged to eat fats and to keep fat, and avoid damp, overcrowded, and badly-drained neighbourhoods. The avoidance of damp and cold is even more important in the rheumatic tendency. If there is a history of drink in the family the only safe course for the children is one of total abstinence from alcohol. This question of hereditary disease naturally leads to the difficult question of marriage into a family with some disease taint. We know that marriage is generally arranged quite independently of any such consideration, and so long as this is the case we shall have families born with disease tendencies, and these would go on increasing if it were not for the fortunate fact that in the course of a few generations such families tend to die out. It behoves every right-minded man and woman to refuse to marry into such families, as in this way much disease would be prevented.

Personal Cleanliness

The importance of cleanliness in all the actions of life is almost too apparent to need more notice were

it not that it is so much neglected by many. Not only cleanliness of the skin, the hair, the teeth, the nails, and the clothing is necessary, but also cleanliness in all our habits. By this means we shall avoid many diseases which are entirely due to dirt of various kinds. The old and excellent definition that dirt is matter in the wrong place even suggests that it should be removed; and when we remember that this dirt may consist of irritating particles of minerals in the form of dust, or of poisonous chemicals, and more commonly and even more fatally of disease germs, we shall be greatly impressed with the necessity of being clean.

The Skin.—A glance at our physiology books will remind us what a very complicated and important structure the skin is, with its myriads of blood-vessels, nerves, and sweat glands, the last constantly pouring out, either visibly or invisibly, a large quantity of excretion called sweat or perspiration. Besides these glands there are the sebaceous glands near the hair roots all over the body constantly pouring out an oily fluid (in some people with very greasy skins in large amount); also the dead scales of the skin are always being cast off. If the skin is left unwashed a cake of dirt, composed of sweat, oily matter, dead skin scales, particles of the clothing, and the dust of the air, forms on the skin and covers it like a plaster. This closes the glands, and as a result stops the important work of the skin as one of the chief means of getting rid of the waste matters of the body, and so throws extra work on other organs which have already sufficient to do. Moreover, as the cake is a good soil for germs to grow in, many skin diseases may result; or the cake putrefies, and causes

the horrible odour which is given off by the skins of dirty people. As all this is constantly going on, we must make arrangements to have this unwholesome cake as constantly removed, and this can only be done by washing.

Warm Bath and Soap.—Now, as the cake of dirt is largely composed of oily matter, it cannot be removed by water alone, but must be dissolved by something which will combine with the oil and make it soluble. Such a substance is **soap**, which is a mixture of some fatty matter and some alkali. On mixing this with water a certain small amount of the alkali is set free, which, acting on the grease of the skin, renders it soluble in the water. For cleansing purposes warm water is far better than cold—firstly, because warm water is softer and more easily mixes with the soap; and secondly, because it softens the excretion from the fatty glands of the skin, and so clears them out better. For cleansing purposes, therefore, the warm bath (at a temperature of about 100° F.) with soap should be taken at least once a week, or if the occupation is a dirty one, twice a week, the whole of the body, of course, to be washed. The warm bath should be taken at night before going to bed, and not in the morning, as there would be a chance of taking cold. In addition to this the hands, face, and neck should be washed morning, noon, and night at least, and the hands always before food, otherwise dirty or poisonous particles on them may be eaten with the food. For instance, workers in white or red lead are not unfrequently poisoned by particles of the lead getting into their food from their dirty unwashed hands. If the feet are hot and objectionable they should also be washed once or twice a day

with hot water, to which a little Condy's fluid has been added. After washing, all traces of soap should be very thoroughly removed with plenty of clean water, otherwise it may itself cake on the skin and close the pores.

Two other forms of bath must now be mentioned. The **cold bath** is an excellent tonic and stimulant to the functions. It should be taken in the morning, but only by robust people, immediately after getting up, both summer and winter, and should always be of a temperature of from 55° to 60° F. It is also most useful as a refreshing application after exercise. The cold bath should be only a few seconds in duration, and the body should be very rapidly dried with a rough towel. This should produce a pleasant feeling of a warm glow all over the body. If there is a chilly feeling, or blueness of the fingers and toes after the cold bath, it has either been too long or has been taken by an unsuitable subject. The cold sponge bath has much the same effect, but is less severe, and the cold shower bath is even more stimulating, but at the same time much more severe and trying to delicate people.

The **hot bath** is taken at a temperature of about 110° F., and is also very refreshing, as it assists the bodily functions, and helps them to rapidly get rid of the waste products of exertion, which are the cause of the feeling of fatigue. It is very excellent after heavy labour, and gives a feeling of rest and comfort, just as sleep does.

Similar remarks as regards cleanliness apply with great force to the washing of the **hair**, the **teeth**, and the **nails**. The **hair** can be kept fairly clean by regular brushing and combing two or three times

a day, but in addition to this it should be washed with soap and water every week or every fortnight. The brush used should not be too hard, as this increases the "scurfiness" of the head. If the **teeth** are not regularly cleaned they become discoloured, and a hard cake, known as "tartar," accumulates on them and tends to loosen them; moreover, the breath becomes foul, and the teeth easily decay, for this process is almost certainly caused by germs resting in small depressions in the teeth and then growing, and cavities result. Much of this would be prevented by the use twice a day of the tooth brush with warm water and some tooth powder, such as camphorated chalk or carbolic tooth powder. The **nails** should be kept fairly short, so that they will not readily take up dirt, and should be kept absolutely clean by a frequent use of the nail brush. Dirty nails are not only unsightly, but the dirt is dangerous, as it may contain germs, and be eaten with the food.

Exercise and Rest

Exercise of all parts of the body is an absolute necessity for the maintenance of perfect health. If a steam-engine is allowed to stand idle it will soon rust and get out of order. Similarly, if the body has no work to do, it will become too fat and the muscles will waste and get flabby, the heart will become weak, the circulation slow and feeble, the blood will not be properly aerated, poisonous products will accumulate in the body, the complexion will be pale, and the intellect dull. If the brain is not regularly exercised the person will merely develop into a muscular

animal, no better than a savage; he will be stupid, ignorant, and uninteresting both to himself and to others.

Exercise.—The effect of regular muscular exercise is to expand the lungs, to increase the amount of oxygen taken in and the carbon dioxide breathed out; the sweat is increased, and so exercise helps to get rid of waste matters from the body. The heart is strengthened, the blood is more aerated, the muscles grow larger, harder, and more active, the appetite and digestive powers increase, the body is kept warm, and the brain is more active and bright as a result of the general health being so good. During exercise more food is required and much pure air.

Very few people lead absolutely idle lives without any exercise, but very many indeed do not take proper exercise. For often our usual occupations do not exercise all parts of the body; some who live what is called a sedentary life (Latin, *sedens*, sitting), doing a large amount of brain work, do not get enough exercise of the muscles; others who exercise the muscles do not exercise the mind, and some muscular work only exercises a few muscles of the body, such as those of the leg in working a sewing machine, or those of the arm in hammering. Now, although we may not be able to alter our occupations, yet we can, as a rule, do something during our spare time which will exercise those parts of our bodies and minds which are not exercised during our business work. This extra work, which we should perform as a distinct and necessary relief from our ordinary labour, may be called **recreative work**, because it recreates or restores the body and

mind, and enables the usual work to be performed with more pleasure and in a more satisfactory manner. To this end the brain worker should take regular gymnastic exercise in a well-ventilated gymnasium, or, better still, regular outdoor exercise, such as walking, climbing, swimming, cricket, or lawn tennis. It is very necessary that such exercise should be regular, as if done irregularly or in "spurts" it will do more harm than good, because the muscles, not being in training, will soon get tired, and the body will suffer. The person whose occupation is an entirely muscular one, such as the common labourer or the blacksmith, should spend his spare time in reading, music, and other mental studies. In other words, every man should have a "hobby" which should exercise faculties as different as possible from the usual occupation. The person who has always something to do will rarely get into mischief, and will probably not be tempted to lead a drunken or dissipated life. There is but little danger in hard and continuous work, provided it is varied and not monotonous; it is not work but worry which kills. The tendency to worry when there is no need, and which is such a prominent feature with some people, should be constantly kept down.

The above remarks as regards exercise apply, of course, not only to men but to women, and to them almost with greater force, as women neglect it to such an extent. There are plenty of forms of perfectly womanly exercise which may be taken, such as walking, rowing, swimming, skating, and lawn tennis, and if these were indulged in regularly we should hear less of hysteria and the weak backs of girls (needing corsets to hold them together), and we should have a

handsomer race, with better complexions and a more stately carriage, and life generally would be more interesting to them.

Rest.—To take our old example again, if the steam-engine is constantly at work it would get more and more out of order, and at last would stop working from the want of repair. So is it with the body, for which regular rest is necessary, in order that the worn-out muscular and nervous systems may be repaired and renewed. This happens during our sleep, when all the functions of the body are at rest, except just enough action of the circulation and respiration to keep us alive. The amount of sleep required varies with the age; the infant needs 16 hours sleep a day; a child of two years, 14 hours; of four years, 12 hours; of eight years, 11 hours; of twelve years, 10 hours; of sixteen years, 9 hours; and for the remainder of adult life, 8 hours for women, and 7 to 8 hours for men; in old age more sleep should be taken.

In order to obtain speedy and comfortable sleep there should be an absence of all external and internal sensory stimuli; there should be no noise, no light, and as few skin sensations as possible. The bedroom must therefore be quiet and dark, warm (about 60° F.) and well ventilated. The bed should be comfortable, fairly soft—a hair mattress put on a spring wire mattress being perhaps better than a feather bed—the pillows should be made of feathers. The sheets should be of cotton, and the other bed-clothes warm, but fairly light in weight. Most people find that they can sleep better lying on the right side, as they do not then hear the beating of the heart so well. Neither should there be present

any other stimuli from the body itself, such as happens if a heavy meal has been taken too soon before going to bed, although if the last meal has been eaten a long time beforehand, a light repast of say a glass of warm milk and one piece of bread and butter will help to bring on sleep. Cold feet, which often cause wakefulness, may be remedied by a hot foot-bath at bedtime, or by a hot bag in the bed. Mental work carried on to too late an hour frequently prevents sleep, the brain, as it were, continuing its active state after the person has gone to bed ; this is easily prevented by stopping all heavy brain work about half an hour or an hour before bedtime, and engaging instead in some very light work, such as reading the newspaper or some light literature, or by playing or listening to music. No infant or very young child should sleep in the same bed as its parents, as it would run a very great risk of being suffocated. Hundreds of infants are killed by "overlaying" in this way every year. They must sleep in a separate cot, which can easily be made by the very poorest people out of an orange box or a clothes basket.

Regularity in all Things.—If we take an example from the action of our hearts and lungs, which in health work and rest with absolute regularity, we shall carry on all the other actions of our life in a perfectly orderly and regular fashion. We must, if we wish to live healthily, have a regular daily action of the bowels, have regular meals and regular hours for business work, for recreative work, and for sleep. Probably the best work done in the world has been done by the most methodical and regular people.

Clothing

The **object of clothing** is to keep in the natural heat of the body, to protect the body from external heat, cold, injury, and dirt, and also for the sake of decency and personal decoration. The last element, though from a health point of view the least important, is in the estimation of the public probably the most important, and any attempted improvement of the dress of the day has to face an almost unconquerable opposition from fashion. Our suggestions, then, we can hardly expect to be fully carried out, but we may hope that in time even fashionable dress may be at the same time healthy.

Bodily Heat.—A few words are necessary to explain that the heat of the body is produced in the body itself as a result of the various chemical changes going on in the tissues, especially in the liver and the muscles, and that heat is given off from the body principally by the skin and the lungs. It is given off from the skin by radiation, by conduction, and by evaporation of the sweat. The amount of heat generated and the amount thrown off almost exactly balance one another, so that the body is in health always kept at about the same temperature of 98½° F. Although this balancing process is always going on, yet we can very much aid nature by means of suitable clothing. A bad conductor, such as woollen, put over the body will keep the heat in and prevent it being lost, and will also prevent external cold affecting the body and cooling it.

Materials used for Dress.—These are obtained from the animal and vegetable kingdoms. From the

animal kingdom we get the furs of animals, the hides, which are tanned and made into leather, feathers, the wool of sheep and similar animals, and silk, which is the thread spun by the silkworm. From the vegetable kingdom we obtain cotton, made into calico, etc., and flax, made into linen. To keep in the heat of the body, and so, of course, to keep it warm, we must use some bad conductor of heat. The best for this purpose is fur, which is used so largely in cold countries, but is too expensive for general adoption. After this comes wool, then silk, cotton, and linen, the last being twice as good a conductor as wool, and therefore much less warm. This is shown by the coldness felt on getting into bed between linen sheets as compared with the warmth of getting between blankets. Although both are of the same temperature, yet as the linen is a good conductor, it rapidly takes away heat from the body, which consequently feels cold. Rough materials irritate the skin and produce a feeling of warmth. This is another reason why woollen materials feel warm, and why flannelette, which is made of cotton but has a rough surface, feels warmer than smooth calico. As air is such a bad conductor, any article of dress which contains much air in its meshes is warmer than a closely-woven material, and this also is the reason why loosely-fitting garments are warmer than tightly-fitting, and also why several layers of clothing, which have, of course, layers of air between them, are warmer than a very thick single layer.

We also have pointed out that the body is cooled by evaporation of the sweat. Any substance, then, which will absorb the sweat into its texture without

feeling wet will prevent rapid evaporation, and will help to keep the body warm. For this purpose fur and wool act best, and then in order silk, linen, and cotton, the two latter taking up the moisture, but at the same time getting quite wet, and evaporation going on from them rapidly cools the body. In violent exercise, for example, when the body is streaming with moisture, it should be clothed in flannel, so that when the exercise is over no rapid evaporation will occur; if clothed with linen or calico, the material would get "wet through," and on standing still and evaporation going on, the person would have a chill, and probably take cold.

Inasmuch as the blood becomes purified to a certain extent during its passage through the skin, the clothing must not be of such a nature as to prevent all evaporation from going on. An animal, if covered with a layer of varnish, would soon die, and we all know the oppression resulting from wearing a long closed-up macintosh during exertion. Clothing materials should therefore be porous, so that the skin may be ventilated. For this purpose wool again heads the list, then cotton, finely-woven silk, and, worst of all, waterproof materials, such as oilskins, tarred cloths, or cloths covered with layers of india-rubber or macintosh. To keep in the bodily heat woollen materials worn next to the skin are therefore the best, not only in winter, but also in summer, especially in this climate, to protect us from chills after being over-heated.

To protect the body from external cold, wool is again the best. To protect us from the heat of the sun a light-coloured material of very light weight is the best for the external garment, as white materials

throw off the heat, while dark ones absorb it. To protect us from the rain some form of waterproof garment should be worn externally, but we must remember not to wear it for too long a time, and it should if possible be thoroughly ventilated. Articles for external wear should not be very inflammable, especially in the case of children, for if they catch fire, death from burns may result. Woollen materials when lighted will not blaze, but simply shrivel up; after this, silk is the least inflammable, then linen and cotton, the last being very inflammable. Materials coloured with poisonous dyes, such as arsenic or some aniline dyes, should not be worn next to the skin, as they may cause eruptions on the skin or produce poisonous symptoms.

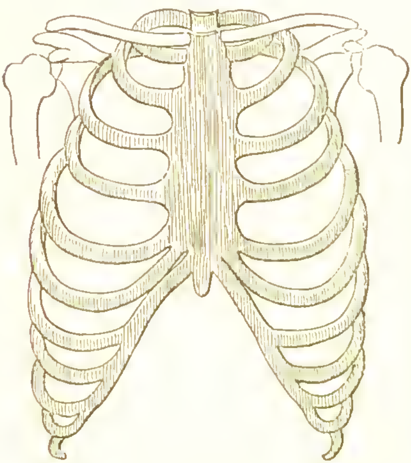


Fig. 17.—Natural skeleton of chest.

Dress Construction. — In constructing a healthy form of dress the following are the most important points to work upon: The materials used must be warm, porous, and absorbent, and fulfil all the other conditions given in the paragraph above. The dress must not constrict the body in any part, or interfere with its movements; it must not give unnatural support to the body; it must be as light in weight as possible; and

the various garments should be suspended from the shoulders rather than from the waist. If we think of the usual construction of dress, we shall find that nearly all these principles are broken. It is perhaps not so much the case with the dress of men, excepting their hats and boots, but it is certainly the case with that of women, where many faults are found, and which are very difficult to remedy because of the dictates of fashion. In women the body is not evenly clothed, the upper part of the chest, the legs, and the arms being too slightly covered and the abdomen too much covered, so that the body is too hot and the hands and feet too cold, and covered perhaps with chilblains. The arms are constricted with tight sleeves, which prevent free movements, and also cause cold hands. The ribs, including the lower part of the chest and the upper part of the abdomen, are tightly compressed by the corsets, and as a result the lungs, heart, liver, stomach, and intestines are displaced, and cannot do their work properly (Figs. 17 and 18). A woman has, of course, a natural waist, but it is situated below the ribs and above the hips, and is not over the ribs, where the corset makes one by compression.

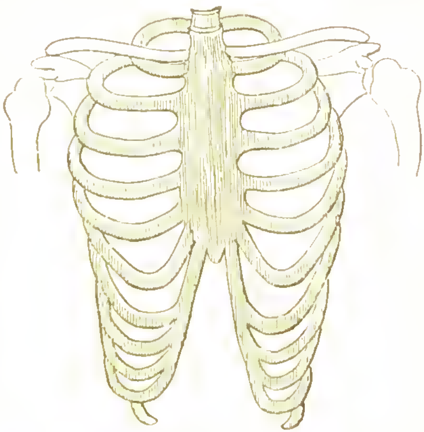


FIG. 18. Skeleton of chest distorted by tight lacing.

It may be said that a woman feels like a jelly if she does not wear tight corsets, but this feeling is entirely due to the very fact that the corsets themselves have for years given an unnatural support to the muscles of the back, which have consequently become weak from disuse; if tight corsets had never been worn they would never be missed. The same remarks apply to tight, stiff, high-legged boots, used to support weak ankles. The way to cure these is to give them no unnatural support, but plenty of work to do in youth. The woman also is impeded in her movements by the heavy skirts which are suspended from the waist, and do not keep the legs warm. She often wears linen or cotton next the skin, which is, as we have shown, very undesirable.

Men's Dress.—The body and limbs should be covered by a layer of flannel worn next the skin. This may be thick in the winter and thin in the summer, for even in hot weather in this uncertain climate flannel should be worn. This layer may be either in the form of "combinations," or made up of a separate flannel vest and flannel pants. Over this comes the shirt, which should be of cotton or linen in summer, and may be of flannel in winter, although many always prefer a linen shirt. The stockings, or rather socks, should be short, made of wool, and no garters are needed. The braces, which should be used to suspend the trousers from the shoulders, should be made of a soft and fairly flexible material which will yield a little with each movement of the body. There should be no constriction of the neck by the collar. The coat and waistcoat should vary in thickness and colour with the weather. The hat,

in whatever form it is, should be measured for, and exactly fit the head, so as not to press tightly on any part. It should be light and well ventilated.

Women's Dress. — The body should be first covered by a layer of flannel reaching to the neck, and thoroughly protecting the arms and legs. This layer may be made in one piece as "combinations," or as two distinct garments. If flannel is too irritating, a thin cotton network bodice may be worn underneath. The stockings should be of wool, reaching above the knees, and should not be fastened by garters, but should be suspended to the garment above. The second layer of clothes should consist of a corset bodice, made to fit the figure of the body (with the narrowest part low down), and not the body to fit the corset. It should not be tightly constricted at the waist, and should be made of a stout material, but contain no hard steels. It should be held in its position partly by resting on the hips and partly by suspension from the shoulders. The heavy flannel petticoat may be dispensed with, and the legs should be covered by a pair of knickerbockers, made of light or heavy cloth, according to the season, shaped much like those worn by a man, and buttoned loosely at the knee. They may be held up by being cut narrow at the waist, where they are buttoned, the band resting on the top of the hip bones. A linen bodice may be worn over the corset, just as a man wears a white shirt over his flannel vest. Over everything comes the dress, which is best made by having the bodice and skirt in one piece, so as not to put the weight of the skirt on to the waist, though, if the skirt is a very light

one, this is unimportant. The dress material should be thick and warm in winter, thin and light-coloured in summer. The bottom of the skirt should be a few inches above the ground, for if it is longer it has either to be held up, which gives an unnecessary amount of work for the arms, and is a great nuisance, as all women admit; or it is allowed to trail in the dirt, which is an utterly filthy and abominable practice. The woman's hat is an almost unnecessary article of dress except for ornament, for with one fashion it is so small as hardly to be seen, and with another is so placed that it cannot possibly protect the head. Fortunately, the hair is generally sufficient for this purpose. Whatever the fashion, the hat should not be too heavy.

Boots and Shoes.—On the whole, when the weather is suitable, shoes are far better than boots, as they allow good ventilation of the feet, which are apt to get very hot and objectionable, and, moreover, there is free play given to the movements of the ankle, which is thereby strengthened. In bad weather, and for work which throws much strain on the ankle, as in rough walking, climbing, or skating, boots are better. The boot or shoe must be made to fit the foot, and not *vice versâ*. If the boot is too small it will distort the foot, displace the toes, impede walking, or cause corns and bunions; if too large it may cause corns by friction (Fig. 19). The heel must be broad and low; the widest part of the sole must be at the widest part of the foot, that is, at the base of the toes, and not near the heel. The inner side of the boot from the heel to the great toe should be in a straight line, just as is the case with the natural foot. The outer

side of the toe of the boot may slant outwards and backwards in a line with the natural slant of the toe-nails. The sole of the boot must be arched and fit into the natural arch of the under side of the foot, and this part of the sole must not be rigid, or it will destroy the beautiful elasticity of the instep. The upper leather of the boot must similarly not be too rigid.

FIG. 19.—Foot distorted by tight boots, and natural foot.

Night Attire.—At bedtime all the clothes should be changed, the day clothes being hung up to be dried and ventilated. The night clothes should be made of cotton, which is not irritating to the skin as woollen is. Sufficient warmth will be given by the bedclothes, which should consist in part of blankets or feathers, and should be light and warm. A woollen night-dress, besides being irritating, promotes too much perspiration, and makes the body hot; but for young children, old

people, rheumatic subjects, or in very cold climates, a woollen night-dress is necessary.

The Clothing of Infants.—Infants and children should be very warmly clad, as the heat-producing powers are feeble. The idea that a child should be lightly clothed, with its limbs bare, so that it may become "hardened," is a great mistake, and little short of cruelty. They should be covered almost entirely with a layer of fine woollen material, and the outer garments should be warm and light. There should be no constriction or artificial support of any part, the clothes being loose, so that the movements of the body are not impeded. No binder should be worn after the first few weeks of life. When taken out, the head should be covered with a warm but very light head-dress.

QUESTIONS

1. What does the term "personal health" include?
2. Which are the principal hereditary diseases, and give the precautions to be taken for each?
3. Why should the skin, hair, teeth, and nails be kept clean?
4. Mention the various forms of baths and their uses.
5. Why are proper exercise and rest necessary for the body?
6. What are the objects of clothing?
7. Mention the articles used for clothing, with the value of each.
8. What are the important points to be borne in mind in dress construction?

CHAPTER VII

THE HOUSE

THE house, or place of residence, of a family depends in its character very much on the wealth and position of the bread-winners. It may be only a cottage either in the town or country, or it may be a palace; but whatever it is, and wherever it is, there are certain general principles which should be borne in mind before a house is built or dwelt in. I know that many poor artisans and labourers cannot choose their dwelling-place, but have to take any residence which is near to their work, and therefore have to take the risk of a house being situated on an unsuitable soil, or being badly built; but still there are some points which they may be able to look after themselves, and perhaps remedy if defective. As sanitary authorities become more enlightened and insist more on well-built property being erected on proper sites, with thorough drainage and plenty of air-space around, then the health of the cottage of the working man will depend more and more on himself.

Situation and Soil

The site of a house should be such that the

house is dry, warm, light, and airy, with a good supply of pure water, and an immediate and perfect system for the removal of sewage. The **dryness of a soil** depends upon the facility with which water can run through it or off it, and on the distance below the surface of the subsoil water. Probably the best sites for a house are on rocks, such as slate

FIG. 20.—Healthy house. *a*, Sand; *b*, rock.

or millstone grit, which allow no water to pass through them, but from which it will run away at once; after these come gravel, loose sand, chalk, and sandstone, which allow water to run through them, and so away from the foundations of the house (Fig. 20). Worst of all is a soil like clay, which takes up a small amount of moisture and retains it, so that it is always damp (Fig. 21). If the subsoil water which exists in most soils at a greater or lesser depth is very near to the surface, then the site will be damp. This will be the case if, although the top layer of soil is gravel, chalk, or sandstone, a layer of impervious soil, such as

FIG. 21.—Unhealthy site. *a*, Sand; *b*, clay.

clay, lies beneath, which will prevent the water running through; the upper layer of loose soil will then simply take up the water, and hold it like a

sponge, and the site will never be dry (Fig. 21). In order to ensure that the site should be dry, it is best if possible to have it on the gentle slope of a hill. If this is impossible, then care should be taken that the site is thoroughly drained by proper tile drains laid in rubble, these drains to have absolutely no connection with the house drains. Peaty soils are, of course, always damp unless properly drained.

The **warmth of a soil** varies very much as its dampness varies, sand being perhaps the warmest, and clay and fine chalk the coldest.

Another danger arising from the soil on which a house is built is the presence of bad **ground air.** This is the air which is held in the spaces between the particles of the soil, and contains a very much larger proportion of carbon dioxide than the atmosphere. This ground air may be forced into a house by a rising of the ground or subsoil water, or may be drawn into a warm house if other inlets for pure air are not provided. Now, if the site is composed of what is known as "made soil," that is, is an old "tip" which has been used for the disposal of all kinds of animal and vegetable refuse and street sweepings, it will contain very much poisonous ground air from the constant putrefaction going on in the deposit, and this will be especially the case if it is damp. Such a combination one gets to perfection in an old clay pit which has been filled in by refuse which is always kept damp by the clay preventing natural drainage

FIG. 22.—House on old clay pit filled with refuse.

(Fig. 22). If there is, however, no other site available for necessary buildings, then the site should be most thoroughly drained, and the whole of the ground covered by the house should be laid with cement (Fig. 23). It has been shown time after time that phthisis, bronchitis, typhoid fever, measles, diphtheria, and other infectious fevers are much more common in those districts where the houses are built on bad sites.

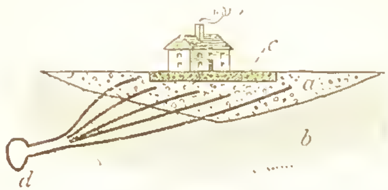


FIG. 23.—Bad site improved. *a*, Refuse; *b*, clay; *c*, concrete; *d*, drain.

In order that a house should get plenty of **light** it should have as much space as possible all round it, or if it is one of a row of houses, the street in front and the passage or entry behind should be sufficiently wide. In this country the **aspect** should, if possible, be such that the principal living rooms face east, south, and west, so that the sunlight may freely enter the rooms. We have long known the beauty and the cheerfulness of sunlight, but it has only lately been proved that it is one of the finest disinfectors we possess, and that under its influence the deadly and ever-present consumption germ soon dies. Our houses must also be so arranged that as much fresh air as possible may get into all the rooms, both front and back. No such abominations as "back-to-back" houses, which are found in the slums of our large towns, should be permitted, for fresh air is even more important for health than sunlight. Trees should not be allowed to grow too near the house, as they make it damp and dark, and prevent ventilation: at

some little distance they are pleasant and harmless, and may protect the house from severe winds.

The Construction of the House

A house should be so constructed that it shall be firm, dry, warm, well ventilated, well lighted, and with no possibility of ground air entering it. To obtain these ends, the walls should be laid on a layer of concrete, and the whole site covered by asphalte or cement, to keep out ground damp and ground air. The **walls** may be made of good whole well-baked bricks or of stone, according to the supplies near at hand: they should be at least 9 inches, or better, 14 inches thick. Near the ground there should be a layer called a **damp-proof course**, which is impervious to water, so that the damp from the ground will not rise into the brick walls, which are themselves porous, like blotting-paper. This damp-proof course is generally made of slate laid in cement, of sheet lead, of asphalte, or, best of all, of impervious tiles, with ventilation holes bored through. If there is a cellar, an area should run round the house, so that the cellar walls shall always be dry. If a proper area cannot be made, the cellar walls should be double, with an air-space between the bricks, to serve the purpose of an area (Fig. 24). The walls must

FIG. 24.—a, Damp-proof courses; b, air-space.

be so constructed that the driving rain will not penetrate them; this is managed by having double walls with an air cavity between, or by covering the outside of those walls chiefly exposed to the weather with pitch, tiles, slate, or cement. The **roof** should be covered with either slates or tiles, with gutters at the sides to take off the rain water, and prevent it running down the walls, these gutters to empty into a rain spout. This should discharge a little distance from the ground over a trap leading to the drain (Fig. 25); it should not run directly into a drain, or be used as the ventilating pipe for a drain. The **chimneys** should not run one into another, and they must not be used as ventilators for drains. The **cellar floor** should be made of cement, about six inches thick, but if the cellar is used as a kitchen, the floor may be made of wood bricks laid in cement, or be an ordinary wooden floor, thoroughly ventilated underneath. The **floors** of the rest of the house should be made of well-seasoned wood, smoothly planed, with no openings between the boards. The space between the ceiling of one room and the floor of the room above should be ventilated from the outside.

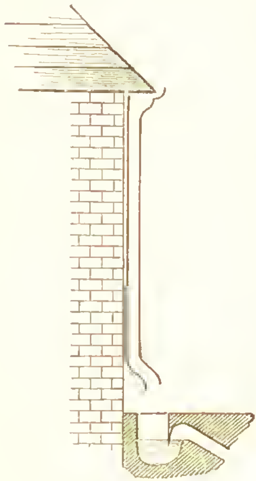


Fig. 25.

The **rooms** must be well lighted by good broad windows, which should reach nearly to the ceiling, and should all be made to open. The ceiling of the

cellar should be distinctly higher than the level of the outside ground, so that plenty of light may enter by the cellar windows. The height of the rooms ought to be about twelve feet; a very low ceiling does not give enough air-space, and a high one does not add much to the available air-space. The arrangement of the rooms depends, of course, entirely on the size of the house, but, as a rule, the principal living rooms should be downstairs, and the sleeping rooms upstairs, and the kitchen should be so placed as not to allow of the smell of cooking getting into the rest of the house.

Decoration and Furniture

The house walls may be either painted, distempered (with some colour wash), or papered, according to taste. As regards papering, care must be taken that the paper contains no arsenic in the colour, as this will gradually be given off and poison the air of the room. All old wall papers should be stripped off before a new one is fixed. The floors are best polished with beeswax and turpentine, and should be kept clean by brushing and polishing, not by washing. They should be covered by a carpet in the form of a square, leaving a margin of polished boards all round. This is much better than having a carpet which fits into all the angles of the room, as it is more economical, and more easily taken up to be cleaned or shaken. The furniture should be easily movable, so that the space underneath can be regularly cleaned. Bookcases and cabinets should have flat tops, which can be regularly dusted, and not hollow tops, which only act as receptacles for dirt. A room

should not be crowded with furniture, only necessary articles being permitted.

Ventilation and Warming

Amount of Fresh Air required.—We have seen in the chapter on air (pp. 17-21) that pure air contains 4 parts per 10,000 (or ·4 parts per 1000) of carbon dioxide; we have also seen that an adult breathes out of his lungs ·6 cubic foot of carbon dioxide per hour. Now, if a man were only supplied with 1000 cubic feet of air in an hour, at the end of the hour the air would contain ·4 cubic foot of carbon dioxide present in it from the first, plus ·6 cubic foot of carbon dioxide breathed out by the man, or altogether 1 cubic foot of carbon dioxide. But we have also seen (pp. 23, 24) that if an atmosphere contains more than 6 parts per 10,000 (or ·6 per 1000) of carbon dioxide it will be close and unfit to breathe, so that 1 cubic foot per 1000 cubic feet is far too foul. Similarly, if we give the man 2000 cubic feet of air per hour, it would contain at the end of an hour 2 × ·4 cubic feet of carbon dioxide in it already, plus ·6 cubic foot breathed by the man, or altogether 1·4 cubic feet of carbon dioxide in 2000 cubic feet of air, that is, ·7 cubic foot in 1000, which is still too impure. A similar sum will show that a supply of 3000 cubic feet of air per hour for each adult would at the end of the hour contain carbon dioxide in the proportion of ·6 per 1000, which is sufficiently pure. This quantity of **3000 cubic feet per hour** is then taken as the minimum amount of fresh air to be supplied to each adult in a room.

Cubic Space.—If every adult had a room to

live in which was 30 feet long, 10 feet broad, and 10 feet high ($30 \times 10 \times 10 = 3000$ cubic feet) he would use up all the air in it in one hour, and it would have to be entirely refilled with fresh air at the end of the hour to prevent a smell of closeness. If two people lived in a room it would have to be twice this size, and so on. Of course, our houses do not allow of such large rooms, so we have to renew the air more than once an hour to keep it pure. If the room were only 7 feet long, 7 feet broad, and 10 feet high ($7 \times 7 \times 10 = 490$ cubic feet) the air would have to be renewed about six times an hour for each person in order to get the proper quantity of 3000 cubic feet of fresh air. It is found, however, in this country that if the air is supplied cold from the outside we can only renew the air of a room about three times an hour; for if we renew it oftener a draught is caused. This leads us to the conclusion that if the supply is cold, each person in a room must be allowed 1000 cubic feet of air-space, which, being supplied with fresh air three times an hour, would give 3000 cubic feet of fresh air per hour. If the air is warmed before admission, then it may be supplied at a greater rate than three times an hour, and so a correspondingly less cubic space would do for each adult. If cold air is supplied, a draught is felt if it is passing into the room at a greater rate than 3 feet per second; but if the air is first warmed, we can admit it at a rate of 5 or 6 feet per second without causing a draught, and so reduce the cubic space for each adult to 500 or 600 cubic feet. Children also do not require more than about three-quarters the quantity of air needed by adults, and so may live in a smaller cubic space.

On the other hand, we must remember that gas or candles burning in a room must be allowed for in calculating the amount of fresh air required (see below, p. 109). I am afraid that in most cottages no such airy chambers as I have described are to be found; in fact, in many the air-space for each person is often only 200 or 250 cubic feet, and as a natural result we see the frequent sicknesses which we have studied in the chapter on impure air.

The **objects of ventilation** are, then, to supply each adult with 3000 cubic feet of pure air every hour, so as to prevent any smell of closeness in a room. There must, however, be no draught created in doing this, and the air of the room must be at a temperature of about 60° Fahrenheit. To thoroughly fulfil these conditions is one of the most difficult puzzles which architects and builders have had to face, and which has hardly yet been satisfactorily settled. We shall now study some of the methods which have been brought forward.

Natural Forces aiding Ventilation.—There are certain natural forces which are the principal agents in ventilation. These are the **diffusion of gases**, which I have sufficiently explained on p. 23, the **winds**, and the movements of air produced by **differences of temperature**. The wind is of great service in the ventilation of ships, where arrangements are made so that it can blow fresh air into the lower parts of the vessels, and extract foul air from the same. It is also an excellent method of rapidly ventilating a room where no one is sitting, such, for instance, as a bedroom after the inmates have risen, by opening the windows and door to let the wind

blow through. The movements of air produced by differences of temperature are very important, and depend on the fact that when air is heated it expands, and bulk for bulk becomes lighter, and therefore rises; when it is cooled it contracts, and bulk for bulk becomes heavier, and so falls. Another fact which depends to a large extent on the last is this, when two neighbouring chambers, such as two rooms of different temperatures, are connected by an opening, a current of warm air will pass from the hot room to the cold room through the top of the opening, and a current of cold air will pass from the cold room to the hot room at the bottom of the opening. This can easily be shown by opening the door between a cold lobby and a warm room to the extent of about half an inch, and holding a lighted candle at the opening. In the middle of the door the flame will burn uprightly, showing that there is no current, but at the top of the door it will be blown outwards, and at the bottom inwards (Fig. 26). Still another point must be borne in mind. We cannot put fresh air into a room without at the same time letting some of the existing air out, any more than we can put more water into a bottle which is already full of water without letting some out. Neither can we take air out of a room without at the same time letting more in to supply its place. As we cannot both let air in and let it out by exactly the same opening at the same time, it is necessary, in order to ventilate a room, that we

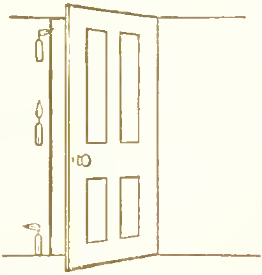


Fig. 26.

should have at least two openings—an inlet to allow air to enter, and an outlet to allow air to escape.

Methods of Ventilation.—Ventilation may be carried on by the natural forces we have mentioned, or these may be aided by artificial means.

True natural ventilation without artificial warming can never be carried on in this country in the winter, as the fresh air supplied from outside would be too cold. It can, however, be used freely in the summer. In considering natural ventilation for the whole year it is therefore necessary to include some artificial warming, and if we suppose this to be managed by the domestic fire, it will enable us more easily to study natural ventilation in its usual or popular sense. Let us examine the ventilation carried on in an ordinary sitting-room with a fire burning in it. The outlet for impure air is the chimney, and the inlets are the open windows, or if these are closed, the small slits between the badly fitting window sashes, round the badly fitting door, through the key-hole, and especially the slit under the door. The fire warms the air in the chimney, which consequently ascends, and the place of the air thus extracted from the room is supplied by fresh air coming through the various inlets mentioned. This cold air rushes towards the fire-place, and some of it immediately goes up the chimney. A certain amount, however, is warmed as it approaches the fire and ascends

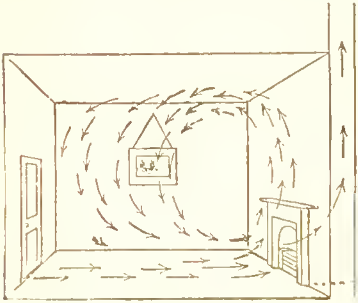


FIG. 27.

over the mantelpiece to the ceiling, where it stays for a short time until it gradually cools and descends gently into the room, goes towards the fire-place, some of it up the chimney, and so on as long as the fire burns (Fig. 27). Such a system, although so common in nearly all houses, is a bad one, as many draughts are produced by the cold air rushing in, the draught from under the door particularly making the feet cold. A great improvement is brought about when by some simple arrangement the cold air entering is given an upward direction, so that it will go at once to the ceiling, and get slightly warm before falling into the room and being extracted by the fire. One method of accomplishing this is to raise the lower window sash about 3 or 4 inches, and fill in the space thus made with a piece of wood, so as to allow no air to come in there. This will have the effect of leaving a space between the upper and lower window sashes in the form of a narrow channel directed upwards; through this the air will enter and be directed towards the ceiling (Fig. 28). Another method is by the Sherringham valve, which is placed near the ceiling. It is a box put in an opening in the wall, and communicating freely with the outer air; the cold air enters it, and is directed upwards by a hinged flap, which falls into the room, and can be opened and closed at will. Another well-known method is by the Tobin's tube, which is a square or round channel, put inside the room against the wall, opening freely at the lower end with the outer air, and at the upper end (which

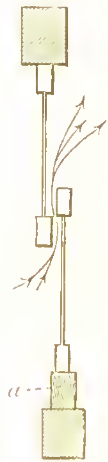


FIG. 28.—*a*, Wooden block.

should be about 6 feet from the ground) with the room. In some cases the entering air may be made to go upwards by having the inlet through a window which is made of a number of glass laths (like the wooden laths of a venetian blind) pointing inwards and upwards, or air may be allowed to enter through **Ellison's bricks**, which are perforated with conical holes, the smaller end of which is on the outside, so that the air coming through is diffused or spread, and lessens the chance of any draught (Fig. 29). If any of the above simple arrangements were adopted we should not be dependent on badly fitting doors and windows for our supply of fresh air. There must be, of course, several inlets for the air, so that it will be diffused as much as possible, and the chances of a draught be lessened.

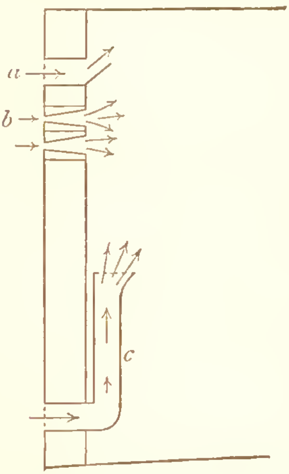


FIG. 29.—*a*, Sherringham valve; *b*, Ellison's bricks; *c*, Tobin's tube.

It will be seen that in all the above examples we have considered the chimney to be the only outlet, as is the case in most houses. And it must be remembered that it acts as an outlet not only when there is a fire burning, but also when there is none, for the wind passing across the top of the chimney draws air from the room. We need therefore hardly insist on the necessity of always keeping the chimney open and never closing it by a bag of shavings or by a board, as is so frequently done, especially in bedrooms.

Artificial Ventilation.—By this term we mean a method of ventilating in which special mechanical contrivances are used, either to drive air forcibly into a room, or to extract it forcibly, or both combined. We shall say but little of these methods, as although they are very necessary in the case of large buildings, such as churches, theatres, mills, etc., they are seldom used in private houses. In one system the air, which may be warmed and filtered from impurities, is driven into the various rooms by means of powerful fans. This is the **propulsion** system. In the other system, known as the **extraction** system, the air is drawn out of the building by fans, and this is an excellent method where the air of the rooms is laden with particles of dust, as in cotton mills; or the extraction may be managed by connecting all the rooms with a central air-shaft, in which there is a strong upward current of air caused by a large fire burning in the shaft. In other cases the gaslights burning in a room may be surrounded by a globe which opens above into a shaft, which not only takes away the foul air of the room, but also the products of combustion of the gas itself (Fig. 30).

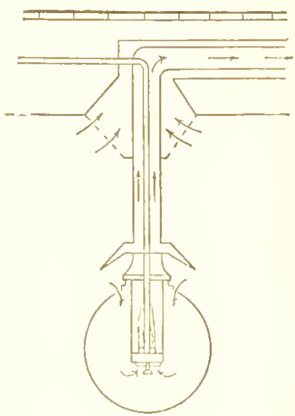


Fig. 30.

Warming of the House. — This subject is closely allied to the ventilation of the house. Heat may be communicated by radiation from a hot body through the air (or even through a vacuum), as is the case with

the heat from an open fire; by convection, even in bad conductors, such as air or water, by the movement upwards of masses of hot air or water, and the movement downwards of cold, as is illustrated in heating by stoves or hot-water pipes; or finally, may be communicated by conduction, which is the passage of heat from one particle of matter to another, as happens when one end of an iron rod or other good conductor is heated and the other end gets hot. The last method is of slight account in the case of air, which is a very bad conductor, and therefore in warming a house we have chiefly to depend on the radiation and convection of heat.

Open fires are the means most largely used for heating dwellings in this country. This system has many advantages. The articles and persons in the room are warmed directly by radiation, and not indirectly by hot air. The air remains of an agreeable moisture, the draught created in the chimney is an excellent extractor of impure air, and, moreover, the appearance of an open fire is bright and cheerful. The disadvantages are that it does not warm a room equally, those persons near the fire being too hot, and those away from it too cold. If the air entering the room is not already warmed, then cold draughts are produced. It is a very wasteful method of heating, as from three-quarters to seven-eighths of the total heat from the burning coal goes up the chimney; and lastly, as the coal is not perfectly consumed, a large amount of impurity is thrown into the atmosphere.

Some of the above disadvantages may be got rid of by having the fire-place on an inner house wall, instead of on an outer wall, and by adopting the

recommendations of Pridgin Teale. He advises that the fire-place should be made of as little iron as possible, to prevent the heat passing to the back of the grate; that the back and sides of the grate should be made of brick or fire-brick, so as to keep in the heat and render the combustion more perfect. The fire-place back should lean forward at the top over the fire at an angle of about 70°, and the sides of the grate should be vertical and inclined to one another, like the sides of an equilateral triangle (60°). The bottom of the grate should be deep from before

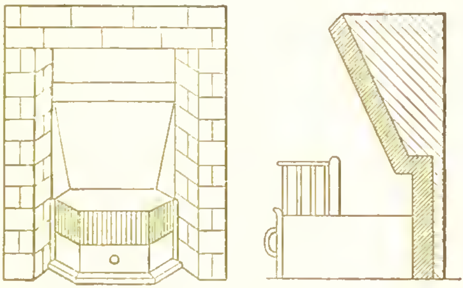


FIG. 31.—Teale's fire grate.

backwards, probably not less than 9 inches for a small room and 11 inches for a large. The slits in the grid under the fire should be narrow, perhaps $\frac{1}{4}$ inch for a sitting-room and good coal, and $\frac{3}{8}$ inch for a kitchen and bad coal. The front bars should be vertical, so that ashes may not lodge in them; narrow, perhaps $\frac{1}{4}$ inch in thickness, so as not to obstruct the heat; and only about $\frac{3}{4}$ inch apart, so as to prevent coals and cinders from falling on the hearth. The chamber under the fire should (after the fire has once been well lighted) be closed by a shield or economiser, to prevent a great and unnecessary draught of air

rushing up underneath the fire and hastening too much the combustion of the coal. Such an economiser can be easily made by a tinsmith, or bought cheaply from the ironmonger. Whenever a fire grate is constructed on the above principles it must be borne in mind that a greater body of heat is accumulated about the hearth than in an ordinary fire-place; therefore special care must be taken that there are no wooden beams under the hearth or behind the fire back (Fig. 31).

Galton has devised a fire grate which not only has the appearance of an ordinary one, but at the same time heats the air which supplies the room. This is managed by having an air-chamber behind the fire which communicates with the open air. This air is warmed by the heat from the back of the grate, and is then carried up by a flue near the chimney (but not, of course, opening into it) to a grating, through which it enters the upper part of the room well above the fire itself; the warm air ascends to the top of the room, gradually falls into the room, and is then extracted when foul by the chimney itself. This is an excellent method of combined warming and ventilation, and exactly corresponds with the best situation of inlet and outlet as found experimentally by Briggs, an American architect, who points out that when a room is ventilated

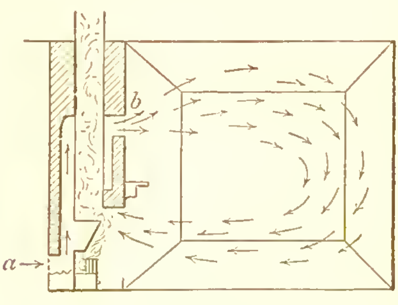


Fig. 32.—Galton's fire grate.

by heated air the inlet should be high and the outlet low, and that both should be on the same side of the room (Fig. 32).

In some houses specially built the whole ventilation and warming are managed by means of the kitchen fire, which is the only one in the house, and is kept burning day and night, and acts like a furnace at the bottom of a coalpit shaft by extracting the foul air. The fresh cold air enters in the basement, and is warmed by passing over a series of hot-water pipes supplied by the kitchen boiler. This hot air is admitted into the hall of the house through the treads of the stairs, whence it passes by various openings into the rooms. From other openings in the rooms the foul air passes by a series of channels to the bottom of the kitchen fire, and is, as we said, extracted by the kitchen chimney. In this system it is better to have no other fires in the house but one, and if the system works well, the windows may even be made not to open if the house is in a dirty and dusty town.

Heating by Stoves and Hot Pipes.—If a house is warmed by any form of stove there are certain essentials, if health is to be maintained. Every stove, of whatever kind, must have a proper outlet for the products of combustion, which should also act as an extractor of foul air from the room. The stove should be so arranged as to be a means of bringing pure and warm air into the room (Fig. 33). Stoves heat the air so much that they make it feel dry, and therefore unpleasant. This can be corrected by placing a dish of water near the stove, so that a little may evaporate and make the air feel more moist. Another greater and more

important objection to stoves is that when coke or anthracite coal is burnt in them much carbon monoxide (a very poisonous gas) is generated, and may pass into the room through the joints, or even the cast-iron casing of the stove. To prevent this the stove should be made of wrought iron, lined inside with fire-brick, and covered outside with tiles. Oil stoves put into the middle of a room are especially objectionable, as they not only use up a large quantity of air, but also give off all their products of combustion, which add greatly to the impurity of the atmosphere.

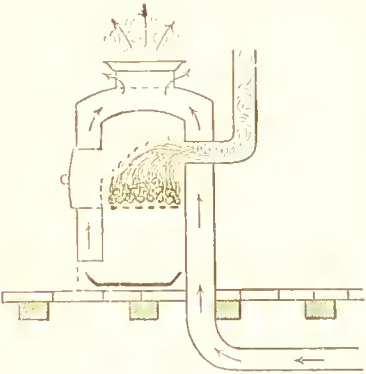


FIG. 33.

If the above points are borne in mind, then stoves may be a great advantage, as with them there is but little loss of heat, a more uniform warming of a room, and they are more economical and clean than an ordinary fire, but, of course, not so bright and cheerful.

Gas fires in which thoroughly-consumed gas heats lumps of asbestos are cheerful, and heat a room by radiation, as an ordinary fire does. They are very convenient and clean, but probably more expensive to keep up than coal fires.

Steam or hot water or air coils are rarely used in sitting or bedrooms, but they are useful in heating the lobby or hall of a house, and so warming the air entering the various rooms, and this they do

without at the same time either using up any of the air or giving off products of combustion.

Artificial Lighting

The house may be artificially lighted by electricity, gas, oil, or candles. Of these, the incandescent **electric light** is by far the best, as the illumination is good, it uses up none of the air of the room, and gives off no impurities; it is, however, expensive, and is at present fitted up in only a few towns.

The most common means of lighting is by **coal gas**, which is very convenient, and comparatively cheap, but, as generally used, has many objections. It uses up the air, and gives off a large amount of impurity, the burning of 1 cubic foot of gas producing 2 cubic feet of carbon dioxide and $\frac{1}{2}$ grain of sulphur dioxide, so that if the atmosphere is to remain pure, 1800 cubic feet of fresh air per hour must be supplied for each cubic foot of gas burnt. This means for an ordinary No. 3 burner (which consumes 3 cubic feet of gas per hour) nearly 6000 cubic feet of fresh air per hour, or twice as much as is required by an adult. Less gas is used and less impurity is given off with a round flame, as in the Argand burner, than with the ordinary flat flame; and even better still is the Welsbach incandescent light, in which a small amount of gas burning perfectly heats to whiteness a peculiar "mantle." Best of all is to have in addition an arrangement by which the gas is enclosed in a globe, and by the principles of ventilation brings in its own supply of air and takes out its impurities, so making it independent of the air of the room. If the gas is at too high a

pressure in the main pipes it will "flare" when lighted. This is not only a waste, but a large quantity of half-burned gas is given off, and greatly adds to the impurities. This may be prevented by having a regulator fixed to the main near the meter, which will only allow a certain amount of gas to pass through, according to the amount being used.

Candles and petroleum oil give off more carbon dioxide than coal-gas, but no sulphur dioxide, which is the body so destructive to pictures, curtains, and books. Candles, however, are much dearer than gas for the same amount of light. Oil is very little if any dearer than gas, and to get the best light with the least impurity a circular wick should be used; the lamp should be a safe one, which will not explode, and which will be extinguished if upset.

Gas-pipes should never be embedded in the plaster of the walls, but should be placed where they can be seen or easily got at to be repaired.

The Water Supply of the House

I have already mentioned most of the important points regarding the water supply of the house, and insisted on the importance of keeping the main supply for drinking and washing purposes absolutely separate from the supply to the water-closet (Fig. 42). In most towns the water for cooking and drinking purposes is obtained directly from the mains, the supply for the bath and hot-water boiler being derived from the large cistern at the top of the house, and the supply for the water-closet being from an entirely separate cistern. These cisterns should be of a proper kind, as indicated before, and should be

placed where they can be easily inspected, and where the water will not freeze. The pipes in connection with them should not be fixed on outside walls or embedded in plaster, otherwise they will be burst by frost. The overflow pipes from the cisterns should not enter any other pipes or into a drain, but should go directly through the house wall, and be cut off short in mid air, so that if the cistern overflows from derangement of the water-valve, warning will be at once given. Where possible, every house should be provided with a bath, which should be considered as a necessity rather than a luxury. The bathroom should be warmed, and should not contain a water-closet. The boiler behind the kitchen fire should not be made of cast iron, but either of copper or wrought iron, with a safety-valve fitted on, to prevent explosion after frost.

The kitchen sink, used for washing various utensils and crockery, should not be made of stone, which absorbs impurities, but of earthenware, or better still, of lead or copper; it should be fixed on an outside wall.

House Refuse and its Disposal

The refuse of the house may be divided into the following classes: 1. *Dry refuse*, such as ashes, dust, broken crockery and glass, waste paper, rags, scraps of animal and vegetable refuse, etc.; 2. *Liquid refuse* or *slop water*, consisting of the water from cooking and from washing the house, clothes, and person; 3. *Human excreta*, containing the waste matters given off by the bowels (fæces) and the kidneys (urine). Now, although most of this refuse is harm-

less when fresh, yet when kept for a short time, and especially when exposed to the action of warmth and moisture, it will soon putrefy and be a danger to health, either by poisoning the air or the water supply. It must all, therefore, be either destroyed or removed to a safe distance as soon as possible. The difficulty of doing this satisfactorily is as great a puzzle, at any rate in large towns, as a perfect system of ventilation. I will give shortly a few of the methods which have been used.

There are, broadly speaking, two systems of refuse removal, one called the **conservancy system** (Lat. *conservans*, keeping), in which the excreta is mixed with the dry refuse, and though kept near the house for a short time, ought to be removed regularly and often; and the other, called the **water-carriage system**, in which the excreta are carried away from the house by a flow of water and taken at once to the drains. Of these the water-carriage system is for towns the best, cheapest, cleanest, and most rapid. In either system the liquid refuse is always removed by pipes to the drains. No refuse of any kind should be allowed to accumulate near a house for a length of time, and such abominations as middens and cesspools (except as explained below) must be forbidden.

Removal of Dry Refuse.—In water-closet towns this contains, as we have said, no excreta. The greater part of this refuse, including the animal and vegetable scraps, should be burnt in the kitchen fire, drying it first, if necessary, under the grate. The ashes should be riddled and the cinders used for fuel. What cannot be used or burnt should be put into a dust bin, which is kept dry under cover in a

well-ventilated outhouse at a little distance from the house. The contents must be removed regularly, say once or twice a week, by the town authorities, to a centre depot, where they may be sorted by machinery, and made use of in some way, such as for mortar, or for heating steam boilers.

In towns where the conservancy system is in use the excreta should be collected in a small pail, kept under the same roof as the dust bin in an outhouse.

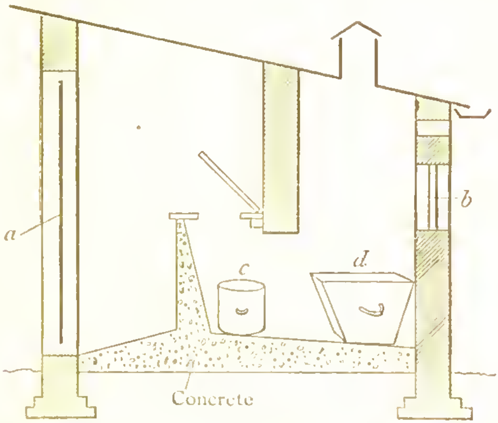


FIG. 34.—*a*, Privy door; *b*, dry refuse door; *c*, pail for excreta; *d*, dust bin.

The ashes should in this case not be emptied into the dust bin, but should pass through a screen, to separate them from the cinders, and fall on to the excreta in the pail, the rest of the dry refuse of the house being, of course, put into the dust bin as usual (Fig. 34). The contents of the pail should be removed several times a week to a central depot, where they may be dried, forming a valuable powdered manure. In the country, or in small towns with plenty of agricultural land near, they should be applied

direct and as soon as possible to the land. If the time of year does not permit of this, they may be buried in a large hole far away from the house or any well or other water supply, and used when possible. In the country, where there is plenty of earth, a still better method of dealing with the excreta is to use an earth closet, placed as before outside the house. This consists of an arrangement by means of which dry earth is thrown into the pail each time it has been used. The best earth for this purpose is loam, the action of which is much better than ashes, as it not only prevents nuisance arising from the refuse, but actually destroys it and converts it into a very valuable manure.

Disposal of Liquid Refuse.—Liquid refuse is generally classed under the one name of **sewage**, and may consist of slop water alone, or in water-closet towns of the excreta as well. Even if it consists only of slop water it contains much organic matter in suspension and in solution, and therefore will putrefy if allowed to remain long in one place, and so give rise to disease. Much more is this the case if it also contains the excreta. The disposal of this liquid refuse is the same whether it contains excreta or not. It must all be removed from the neighbourhood of houses as rapidly as possible, and for this purpose many pipes and channels are necessary, and it is often from the want or bad arrangement of these that diseases and nuisances are likely to arise. In towns the sewage should be taken away rapidly by sewers to large tanks, where it is allowed to settle naturally, or made to settle artificially by the addition of some chemical. The resulting sludge is used either as manure or fuel, and the more or less

clear liquid is drawn off and filtered in various ways through land, on which crops can be grown to great advantage. If this has been thoroughly done the bulk of the putrescent matter is removed, and the liquid thus filtered is clear and fairly pure, and may be allowed to pass into the nearest river. No sewage should be allowed, either in town or country, to pass into brooks or rivers without some such filtration as

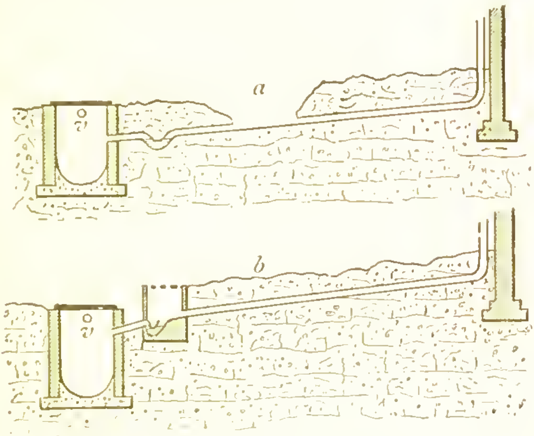


FIG. 35.—Cesspool, disconnected by open culvert, *a*, and by air-chamber, *b*; *v* is a ventilation pipe.

I have mentioned, otherwise it will be a source of danger by poisoning the air and the water supply. In small villages the slop water, which, as a rule, contains no excreta, may be discharged from the sewers directly on to land where osiers may be grown, and after this filtration may pass into a stream. If there are no sewers in the district, as in small scattered country places, then each man who has land should arrange for the slop water from his house to run over and manure his fields. If this is

not possible at all seasons, the liquid refuse may be taken by a drain into a cesspool, which must be at some distance from the house. This cesspool must be quite water-tight, covered in, ventilated, and not allowed to overflow, and a pump should be connected with it, by means of which its contents can from time to time be removed and put upon the land. It must be disconnected from the drain by an open culvert, or an air-chamber and a trap, such as I shall describe in separating a drain from a sewer (Fig. 35).

Manure heaps, piggeries, cowsheds, and stables

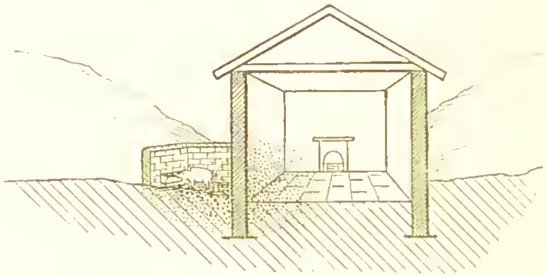


FIG. 36.—House polluted by pig sty.

must never be next to the house wall, as the filthy liquid would soak through. They should be placed on a layer of cement, so that any liquid from the refuse will pass from them into proper drains, and not penetrate the ground, and so poison wells and fill cellars with putrid matter (Fig. 36).

Sewers are channels which take away sewage from several drains, and should be made of pipes or of special bricks, and be round or egg-shaped on section according to their size. They should be properly ventilated, so that the gases in them may not be forced into the drains, and then into houses. They

may be made to take not only the sewage, but also the rainfall of the district, but it is better, if possible, to have two sets, one to take the rainfall only, which may empty into the river at once, and the other to carry the sewage only and take it to the land, as I have described above.

A drain is the channel which takes the sewage from only one building to the sewer. It must be made of stoneware pipes connected by perfect joints, must be water-tight and laid on concrete, so that it will not give way and break from the ground sinking. For an ordinary house it must be four inches in diameter, the inside must be quite smooth, and it must be laid as straight as possible. If a curve is necessary it should be as gradual as possible, a few curved pipes being used at this point. If one drain runs into another they should join like the letter V (Fig. 37), a special drain pipe being used for this purpose. The drain must have a gradual fall from the house towards the sewer of about 1 in 40 or 60, so that the contents will pass away rapidly. It should, if possible, not run under the house, but if this cannot be avoided it must be set in and completely covered over with concrete, to prevent it leaking and the contents soaking into the ground under the house. The drain must be thoroughly ventilated by an opening at each end, so that a stream of fresh air may always pass through

FIG. 37.—Drain pipes showing (a) a curve and (b) a junction.

when it is not in use. One of the ventilating pipes at least should be carried up the side of the house well above the roof, and should not open near a chimney or an attic window, otherwise sewer gas may enter the house. The drain must empty at the sewer end into a chamber called an intercepting chamber, which can be entered and cleaned if necessary, and which, covered only by a grid, acts as a ventilating opening

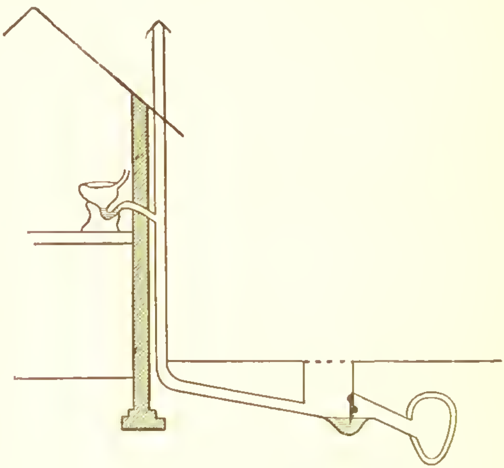


FIG. 38.

for the drain, and also cuts it off from the sewer, the sewage passing from it to the sewer by a syphon trap such as I shall describe (Fig. 38).

We must now study carefully the various means by which one set of pipes can be shut off from another to prevent the entrance of sewer gas into houses. These contrivances are known as traps, and are so arranged that a barrier of water, called a "water seal," is placed between one set of pipes and another. Some of these are very badly constructed,

and should be replaced, whenever found, by one of good construction. The bad and useless traps are the bell, the dipstone, and the D trap. The **bell trap** (often found in cellars) is too shallow, so that the water easily evaporates and "unseals" the trap, it becomes choked with grease, the bell frequently breaks, and if the top is removed for cleaning, the drain itself is at once exposed. The **dipstone** or **mason's trap** is really a cesspool of the worst kind,

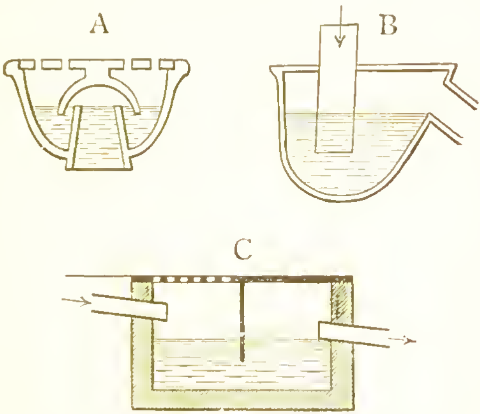


FIG. 39.—A, Bell trap; B, D trap; C, mason's or dipstone trap.

retaining all the solid filth. The **D trap** is of such a shape that it can never be properly flushed with water (Fig. 39).

The good traps are the **syphon** and the **gully traps**. The syphon trap (Fig. 40), of which there are many forms, mostly either U shaped or S shaped, should have a water seal at least $1\frac{1}{2}$ inches deep, and if fixed in the ground, such as for cutting off a drain from a sewer, should have a flat bottom to keep it in position. If there is no intercepting air-

chamber between the drain and the water seal, a ventilation opening must be provided; and, if necessary, an opening (generally, however, to be tightly sealed) may be provided on the sewer side of the trap for inspecting that part of the channel if it gets blocked up.

For syphon traps used in the course of a slop-water or soil pipe, the S shape is used. If for slop water, it should have a screw plug at the first bend

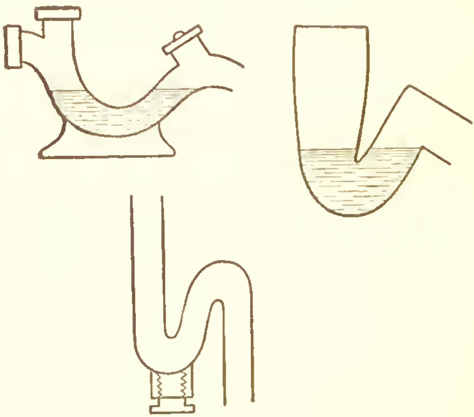


FIG. 40.—Various forms of syphon trap.

from the sink, so that it can be easily cleaned by removing the screw. In some cases, and especially with soil pipes, the water may be drawn by syphon action entirely out of the trap, thus rendering it useless for a time. To prevent this, a small pipe should run from the second bend of the syphon upwards to the ventilating pipe.

The **gully trap** (Fig. 41) is used for cutting off the various waste pipes of the house (or in other words, the pipes carrying the slop water) and also the

rain pipes from direct connection with the drain; it is also used in open yards to collect the rainfall. It is in the form of a square box covered by a grid, and opens into the drain through a water seal. If there is much solid matter in the slop water, a bucket should be placed in the trap, which will retain the solid matter, and this can then be easily removed from time to time. Such a trap should never be put inside a house or in a cellar, as if not regularly used, the water will soon evaporate and the trap become useless; or the pressure of sewer gas in the drain may force itself through the trap; or the water in the trap may absorb the sewer gas from the drain and then give it off into the house. Cellars should be drained by having a sloping channel, which will take off the water to a gully trap in the area outside the house. If this is impossible, and a gully trap does exist in a cellar, it must be regularly flushed with fresh water two or three times a week in winter, and every day in summer.

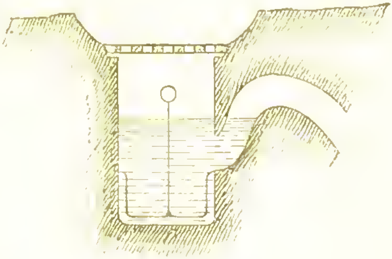


FIG. 41.—Gully trap.

The waste and overflow pipes from all sinks, lavatories, and baths must have an S syphon trap in their course, and the pipes must then run by as short a course as possible to the outside of the house, and discharge into the open air about 18 inches above a gully trap. The rain pipes from the roof should discharge in a like manner. A rain pipe may be allowed to receive the slop water from an upstairs

room, but it must on no account be used as a ventilating pipe for a drain, as it does not reach above the eaves of the house, as a drain-ventilating pipe should. As I have before stated, none of the above-mentioned pipes must communicate in any way with the soil pipe (Fig. 42).

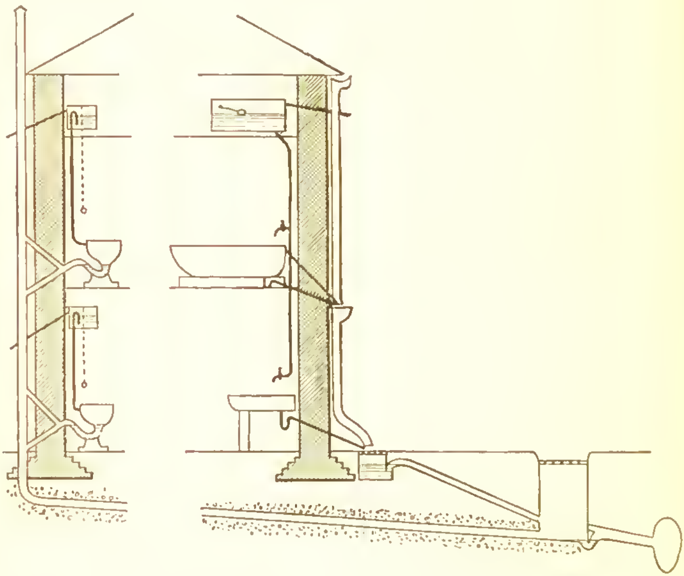


FIG. 42.—House with good sanitary arrangements.

The chamber containing the water-closet should be placed against an outside wall of the house, and should, if possible, be shut off from the rest of the house by a small passage which has a through ventilation. The water-closet itself must be of a simple type, not boxed in by wood, and the seat should lift up on a hinge, so that vessels from bedrooms may be emptied in without wetting it. The

closet pan must be fed with water from a separate cistern, with a good flush of at least two gallons of water. The old-fashioned valve closet with the container should not be allowed, as it can never be properly cleaned, the container being out of sight and being constantly foul (Fig. 43). The long hopper is also objectionable, because of the fouling of the long sides, which cannot be properly flushed. The wash-out closet (Fig. 44) is much better, but not the best, as the flush is broken by the shape of the pan, is

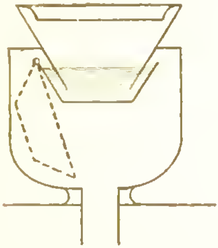


FIG. 43.—Old-fashioned valve closet.

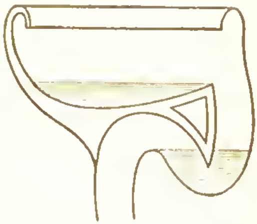


FIG. 44.—Wash-out closet.

therefore not thoroughly effective, and much splashing may occur. The wash-down closet (Fig. 45) is probably the best of all, as the objections to the wash-out are avoided.

The connection between the water-closet and the soil pipe must be of lead, and fitted by perfect joints. The soil pipe itself must be made of lead, or of uncorrodible iron, and put entirely outside the house.

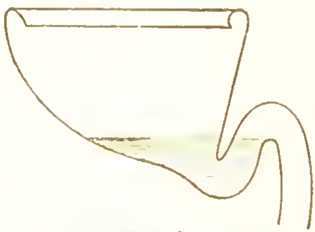


FIG. 45.—Wash-down closet.

It must be ventilated by a pipe of the same diameter, carried well above the roof, and at its lower end

should pass into the sewer, either by a proper syphon trap, which allows free ventilation of the soil pipe, or into a disconnecting chamber; or in small houses it may pass directly into the drain pipe, which, as we have said, is itself disconnected from the sewer (Fig. 42).

QUESTIONS

1. What are the best and the worst situations for a house?
2. How should house walls be constructed so as to prevent damp?
3. What is the amount of fresh air required for each adult in an hour, and why?
4. What are the objects of ventilation?
5. What are the natural forces aiding ventilation?
6. How would you ventilate and warm a small room without causing a draught?
7. What is the best construction of a fire-place?
8. How should the water supply of a house be arranged?
9. What does house refuse consist of?
10. Give some methods for disposing of dry refuse.
11. Give some methods of disposing of liquid refuse in town and country.
12. What are the worst and the best "traps"?
13. How should the water-closet arrangements of a house be constructed?

CHAPTER VIII

INFECTIOUS DISEASES AND THEIR PREVENTION

DISEASES which may be communicated from one person to another, or from an animal to man, are known as **infectious** diseases (Lat. *infectum*, to taint or infect). Some of these, such as itch, lice, ringworm, hydrophobia, and a few others, can only be communicated by actual contact with a diseased animal or person, and so are called **contagious** diseases (Lat. *contagio*, a touching of something unclean); but it must be distinctly understood that some of the other infectious diseases, although generally carried in a different way, may also be conveyed by touch.

Of the infectious diseases caused by animal parasites I shall not speak further, as they have been already dealt with (p. 8), and we shall now examine more minutely those caused by the vegetable parasites or germs

How Germs are conveyed and received.—Germs may be carried from one person to another, and received by that person in different ways. They may be conveyed by **actual contact**, as in the case of ringworm, erysipelas, ophthalmia (infec-

tious inflammation of the eyes), hydrophobia, small-pox, etc. The germs may possibly be taken in through the unbroken skin, but much more frequently through a small crack or sore in the skin. Secondly, they may be conveyed by the **air**, and taken in by the breath. This is by far the commonest method, as seen in whooping-cough, scarlatina, smallpox, diphtheria, measles, ague, consumption, etc. Thirdly, they may be carried by **water**, and so taken into the stomach and intestines, as with cholera, typhoid fever, dysentery, ague, etc. Fourthly, by the **food**, and taken to the stomach and intestines as before, as with typhoid fever, consumption, and foot-and-mouth disease (conveyed by milk). Lastly, they may be carried by **clothes**, and so get into the air, as with scarlatina.

Of all diseases due to germs probably only one, namely the marsh fevers or ague, cannot be conveyed from one person to another. In this case the germ lives in marshy ground, and so gets into the air and water of marshy districts, and only affects the people living in the district. It is now almost unknown for it to be "caught" in the British islands, since marshes have been more thoroughly drained.

Meaning and Course of a Fever.—Most of the illnesses set up by germs are popularly known as fevers. Now, fever really means a condition in which the body temperature is raised, and which may be caused by other things than the presence of germs in the body. For the sake of simplicity, however, we will consider the term fever to mean one of the infectious fevers due to germs. Most of these run a certain course. First, we have the

infection when the germ enters the body; then the **incubation** (Lat. *incubans*, hatching), during which the germ is, as it were, brewing in the body, without showing its presence by any bad effects; thirdly, the **onset** of the fever when the symptoms begin: fourthly, the **height** of the fever, sometimes occurring with a **rash**; fifthly, the **decline** of the fever; and lastly, **convalescence** when the patient is getting strong again.

Besides these various points in each fever we must know the place in an affected person from which the germ comes, and the way in which it is received by another person, and the particular time when a person with fever is most infectious, and how long he will remain infectious.

I shall now apply the above remarks to the commonest fevers, only saying so much about them as every man and woman should know.

Measles.—The germ is almost certainly found in the breath, and enters the body with the air breathed. The incubation period is fourteen days, and the fever begins (onset) like a cold in the head, with running of the eyes and nose. The rash comes out on the fourth day (from the onset), when the fever is almost at its height. It appears first on the face as a red, mottled, irregular eruption, and rapidly spreads over the body. The fever declines suddenly (crisis) about the seventh day, and a very slight peeling of the skin, like scales of bran, may follow. There is often bronchitis and inflammation of the lungs, so great care must be taken to protect the patient from cold. The disease is most infectious in the early stages before the rash has come out, and therefore before the disease can be properly recog-

nised, and thus it may rapidly spread through a school or village. The person should be kept separate from others for at least three weeks from the commencement of the attack.

Scarlet fever is exactly the same disease as scarlatina. There is a common idea that the latter is a mild and non-infectious form of the disease, but this is quite a mistake. The germ is contained to some extent in the breath, but more especially in the pieces of skin which peel off the body, and in the discharges from the throat and ears. It is taken into the body by the breath, and is also very readily carried by clothes which have been in the sickroom, even if they have been put aside for a year or more. The incubation period is from two to four days, and the attack begins by sudden vomiting, sometimes a shiver (or in children, a convulsion), a hot skin, a very rapid pulse, and a sore throat. The rash comes out on the second day on the chest and thighs, and rapidly spreads over the whole body as a uniform scarlet colour, like that of a boiled lobster. This remains out for about three days during the height of the fever, and then they both gradually decline. About the tenth day the skin begins to peel off, first on the chest and legs, and then from the rest of the body, and on thick parts like the soles of the feet and palms of the hands it comes off in large flakes. These pieces of skin are highly infectious, and none should be allowed to get into the air, but should be burnt at once. The peeling process may only last for about a week, but much oftener lasts for four or five weeks, and this is a time of great danger, as, if the patient is exposed to cold, his kidneys are likely to become affected, (as

shown by dropsy in the face), and death may result. The ears may be affected, and may discharge matter which contains germs. Scarlatina is most infectious during the "peeling" stage, but is somewhat infectious even in the early stages when the throat only is affected. The patient must be kept separate from others until all peeling of the skin and discharge from the throat and nose has ceased.

German measles is an infectious disease, quite distinct from true measles or scarlatina, but in which the rash may be like that of either of the two latter. It is a very mild affection, causing little suffering, and is practically never fatal, so I shall say no more about it, except that it must be managed in the same way as all other infectious fevers.

Chicken Pox.—This is a mild disease, which may, however, leave disfiguring scars on the face or body. The germ is probably in the breath and the pocks, and is most likely received by the air breathed and by contact. The incubation period is about fourteen days. The disease begins with slight fever, and on the first day a crop of little lumps appears in various parts of the body, and these then become filled with clear fluid, which finally dries up, and scabs form, which drop off, and a scar may be left. The disease is infectious for about four weeks, or until all the scabs have dropped off.

Smallpox is probably the most infectious of all the fevers, and until compulsory vaccination came into force was the cause of thousands of deaths and great suffering and disfigurement. The germ is probably found in the breath, and certainly in the pustules and scabs, and is readily conveyed by contact, by clothing, and by the air, being received into

the body with the air breathed. The incubation period is twelve days, and the disease begins with violent shivering, vomiting, severe pain in the back, and high temperature. On the third day the rash comes out in the form of small lumps like shot under the skin, generally first on the forehead and face, and then over the rest of the body. These little lumps may be few in number, and separated one from another, as in mild smallpox, or they may be very numerous and close together in the severe forms. The lumps become little vesicles or "pocks" containing clear fluid about the sixth day of the fever, and about the ninth day the clear fluid becomes yellow, and forms "pus," or matter. Scabs then form, and continue till about the twelfth day, when the danger to life is the greatest. The scabs begin to fall off about the fourteenth day, and this continues for two or three days, often leaving scars or "pits" on the skin. If the disease is mild, or modified by the person having been vaccinated at some time, the course of the disease is much shorter, and there is little danger to life. Smallpox is highly infectious throughout the whole duration of the attack, and the patient must be kept separate from others until every scab has fallen off and all the sores have healed, a period of about five weeks.

Vaccinia or Cowpox.—This is the condition produced purposely in man by what is known as vaccination, and is neither more nor less than smallpox in a very mild and harmless form. It is compulsory in England that all children must be vaccinated before they are three months old, in order that they may be protected from true smallpox. The little operation is performed by making a few slight

scratches on the arm, and then spreading on them a small amount of clear fluid called vaccine lymph, which is taken from the little blebs or vesicles on the arm of a child who has been similarly vaccinated seven days before, or the lymph may be taken from the vesicles of a vaccinated calf, or the so-called calf lymph. At least three separate marks should be made on the arm, or better still, four, as one or two marks only do not sufficiently protect from true smallpox. The operation is practically painless, and if carefully done, is absolutely safe, and in healthy children no bad results should follow. About three days after the arm has been vaccinated small lumps or papules begin to grow on the places, which become also slightly red. These then show some clear fluid in them, and become vesicles, which are well developed on the eighth day. After this the clear fluid turns to matter or pus, then a scab forms, which ultimately, about the fourteenth day, falls off and leaves the well-known "vaccination mark." During this process the place should be protected from the air and from the friction of the clothes by a piece of clean linen, spread with some simple ointment, such as vaseline, and over this a proper guard to prevent injury. This primary vaccination will protect against smallpox almost absolutely for about twelve years, and partially for the rest of life, that is, if smallpox is taken, it will only be of a very mild kind, and not cause death. Every one should, however, be revaccinated about the age of twelve years, and then they are almost absolutely protected for the whole of life. If an adult who has not been revaccinated for several years happens to be exposed to a smallpox case he should be vaccinated at once,

or at any rate before three days have elapsed, and then even if he has been infected with smallpox, he will only have a very mild attack.

It is impossible here to give a history of vaccination, or to deal with the objections and false statements of a few foolish people who call themselves anti-vaccinators. It will be sufficient to mention that since the introduction of compulsory vaccination into England the death-rate from smallpox has enormously decreased, and that in Germany, where both primary vaccination and re-vaccination at the age of twelve years are compulsory, smallpox is practically unknown.

Typhoid or Enteric Fever.—In this disease the germ is almost entirely found in the stools. It enters the body by the mouth, being carried either by water, by milk, by sewer gas getting into the air, or directly from the soiled sheets by the fingers of those who are nursing cases of typhoid fever, and are not careful to keep the hands perfectly clean. The incubation stage is about fifteen days, and the disease commences by headache, sometimes bleeding of the nose (in children), a feeling of illness, and violent purging. The skin gradually gets hotter, and a rash of little raised red spots on the abdomen may appear. The fever declines gradually in the third week, and this is a time of great danger, as bleeding or perforation of the bowels may occur and cause death. The patient must therefore be kept constantly on the back, and must be handled with the greatest care. No solid food of any kind must be given for about five weeks from the commencement of the fever (or until the doctor orders), otherwise a relapse may occur, and a fresh attack follow. All

the stools must be carefully disinfected as soon as they have been passed, for if they are allowed to stand about they will poison the air in the room; when poured down drains these must immediately be flushed with disinfectants. As the infection is probably only contained in the stools, the patient is only infectious while the diarrhœa lasts, that is, for about three weeks. There is probably no danger of being in the same room as the patient, provided that the stools are properly dealt with, and any soiled sheets immediately removed and disinfected.

Typhus fever is more common in Ireland and Scotland than in England. It is caused by a germ, but only affects people who live in overcrowded and badly-ventilated houses, as the germ is rapidly killed by fresh air. The germ is found in the peculiar odour given off by the patient's skin and in the breath, is carried for a very short distance only by the air, and is taken in with the air breathed. The incubation period is from four to twelve days, and the disease begins suddenly with shivering, high fever, headache, and delirium. A peculiar dirty, mottled-looking rash with purple stains comes out about the fifth day. The fever lasts for fourteen days, during which time the patient is in a stupid, almost unconscious state, and requires to be constantly nursed and regularly fed to keep up the strength. The disease ends suddenly about the fourteenth day, but the total period of infection is about three weeks from the commencement. As fresh air so rapidly kills the germ, in a well ventilated room the poison is only to be found quite close to the patient's body; therefore it is especially necessary in cases of typhus fever to

have a plentiful stream of pure warm air always travelling through the sick-room.

Diphtheria.—The germ is found principally in the breath, and the disease can be carried by air, by water, by direct contact, such as kissing, and very probably can be caused by sewer gas alone without going near an infected person. The germ is very tenacious of life, not being easily killed by fresh air, and it must be borne in mind that probably most cases (though not all) of so-called croup are in reality diphtheria. The incubation period is about two days, and the disease begins with sore throat, much weakness, and swelling of the glands in the neck. A yellowish white skin soon forms in the throat, and as it extends causes a croupy cough and a choking sensation, which may finally lead to suffocation if an operation is not performed. The kidneys may be affected, and afterwards paralysis may come on. The patient must not be allowed to sit up during his illness, nor for a short time after, or fatal fainting may be caused. It has been found that the living germs still exist in the mouth for about a fortnight after the throat is better, so that a disinfecting mouth-wash should be used. The total time of infection is about three weeks.

Whooping Cough.—This is very infectious, and causes a large number of deaths in young children. The germ is contained in the breath, carried by the air, and taken in by the breath. The incubation is about ten days. Then the disease begins with an ordinary cough, which in about a week always starts with a peculiar and characteristic "whoop" as the breath is drawn in, and then coughing follows, very often until the child is sick. The lungs become

affected in many cases, and death may result. Children affected should be kept in the house during the illness, as if they are exposed to cold air the disease will be prolonged and the lungs may be affected. The affection may last for three, or even six weeks, and the patients are infectious until the cough has entirely ceased.

Mumps.—This is very infectious, but rarely causes death. The germ is probably contained in the breath and in the saliva or spittle. The incubation period is about eighteen days, and the disease begins with pain at the side of the jaw and enlargement of the salivary gland just below the ear. There are but few other symptoms; it is infectious for about three weeks.

Phthisis or Consumption.—I wish to dwell at some length on this infectious disease, because it has so long been considered a non-preventible disease, and because it causes more deaths in England than any other single disease, as many as 60,000 people dying every year in Great Britain from this cause alone. As I have before said, it is really caused by the tubercle bacillus or germ, but there are many conditions which favour the growth of this germ in particular people. There is first of all an undoubted hereditary predisposition to the disease—that is, a special weakness of the body to resist the germ is handed down from parents to children, and where such a weakness exists very special care must be taken to avoid the bad conditions to be now mentioned. It is most prevalent in dwelling-houses situated on damp, cold, and undrained soils; in dwelling-houses in which, owing to faulty construction, the foundations or walls are damp; in places where there

is no free admission of fresh air and sunlight,—as in the slums of our large towns,—and where there is imperfect ventilation of the rooms of the house. It is more frequent amongst those who work in hot, ill-ventilated, and dusty rooms, and where a stooping attitude is necessary. Phthisis is therefore more commonly found in towns than in the country, more in men than in women, more amongst the poor than the rich, more in narrow streets, alleys, and courts, and in back-to-back houses, and more in the intemperate than in the sober. It is rarely found in wandering tribes in the desert or amongst the mountains. It must be considered as practically certain that one case of phthisis has always been "caught" from some other case of phthisis, just as with other infectious diseases.

It is possible that the germ may be contained in the breath of a person suffering from phthisis, but it is most especially contained in the sputum or spittle of the patient, just as the scarlatina germ is contained most particularly in the peelings of the skin. It is to the sputum of the consumptive patient, therefore, that we must pay special attention. It is perhaps not so dangerous when in a wet state; but as soon as it becomes dry, it easily enters the atmosphere as part of the dust, and then the germs are taken into the bodies of other persons by the breath. These germs have been found in the dust of a house where a consumptive patient has lived, in the curtains, the carpet, the bedding, and even in the plaster of the walls.

The sputum constantly brought up by a consumptive patient must not be swallowed by him, or it may affect the bowels; he must spit into a proper

spit-cup containing some strong disinfectant, such as carbolic acid or corrosive sublimate. The contents of the cup must never be allowed to become dry, but must be poured away frequently. If the patient is outside, he must not spit on to the street or pavement, but must use a pocket spittoon made of glass, and containing some disinfectant, and the contents must be burnt as soon as possible. The mouth must not be wiped with a handkerchief, but with a piece of rag, to be afterwards burnt. All spoons, crockery, etc., must be used only by the patient, and disinfected with boiling water after use. No person must sleep in the same room as a phthisical patient, and bedrooms which have been occupied by them must be thoroughly disinfected (in the manner given below) before being occupied by others. As a result of carefully carrying out these precautions in some parts of Germany for the last few years there has been an enormous decrease of consumption, and the English nation should not be behind-hand in trying to stamp out this terrible disease.

Why Children should not be purposely exposed to the Infectious Fevers.—It is the custom with some ignorant mothers to purposely expose their children to mild cases of fever, especially measles, chicken pox, and scarlatina, because they say the children are certain to get them at some time or another, and in this way they think their children will have mild attacks which will protect them in the future. Such a practice is almost criminal, and should be absolutely condemned, and for the following reasons: It is not certain that a child will have fever at some time or another; if proper precautions were taken it would not have an

infectious disease. A mild attack in one person is not always followed by a mild attack in another, but may give rise to a very serious one. One attack of fever does not necessarily prevent a second attack of the same fever at some future time. The death-rate in children suffering from most fevers (such as measles or scarlatina) is always greater than in adults. Finally, as a rule, the older a child grows the less likely is it to be attacked by a particular fever.

Precautions to be taken when Fever is in a House.—When a person is attacked by an infectious fever, the best way to prevent the spread of the disease, and, at the same time, the best thing to do for the sake of the patient, is to send him to the nearest fever hospital. Here he will obtain the best treatment and most careful nursing, and will not be a danger to the rest of the community. If this is impossible, and the patient has to be treated at home, he must be kept separate, or isolated, as it is termed, from all other people except the nurse. The bedroom must be at the top of the house (or better, in a detached wing), and all unnecessary articles of furniture must be removed. Thus, bed curtains, window curtains, carpets, stuff-covered chairs, and books must be taken out. The windows must be such as will open for ventilation, and there must be a fire-place in the room with a fire constantly burning day and night, summer or winter. The fire is necessary because it acts as an extracting ventilator, and also as a means of at once burning infected articles, such as rags. Outside the door should be hung a large sheet, completely overlapping the whole of the door, and trailing on the ground. This must be constantly kept moist with a strong

solution of carbolic acid. The nurse should not wear a woollen or stuff dress, but a cotton one, which can be readily disinfected and washed. If she goes out, she should first wash in some disinfectant and change her outer clothes. She must on no account mix with the other people in the house; all food, coals, and other necessaries should be taken to a certain point on the staircase, and left there, and in a few moments the nurse should go and fetch them. Similarly, no articles, such as spoons, crockery, or clothes, should leave the room without being first disinfected, and then they should be left on the staircase by the nurse, and at once removed by those downstairs. The stools of the patient must be disinfected as soon as passed, and any discharges from the eyes, ears, throat, nose, etc., must be wiped away with pieces of clean rag, which must be at once burned in the fire. If the patient wishes to read during his convalescence he must only be allowed such books as can be destroyed by fire after he has done with them. To supply such a patient with books from a public library is criminal, and is punishable by law; in fact, any exposure in any public place or conveyance (without previously telling the owner), or the giving away, lending, or exposing (without previous disinfection) of any infected bedding, clothing, etc., is also punishable. During convalescence in fevers like scarlatina and smallpox, where infecting particles, such as skin or scabs, are given off from the body, the surface of the body must be kept moist with some oily disinfectant, such as carbolic ointment, to prevent these particles getting into the air.

Disinfection after Fever has been in a

House.—In many towns the sanitary authorities will disinfect a house free of charge. If it has to be done by the householder the following is the best method. If the patient has been properly isolated it is only necessary to disinfect that part of the house which has been occupied by the nurse and patient. If possible, all removable articles, such as mattresses, pillows, and bed-clothes, should be taken in a proper conveyance to a public disinfecting chamber, and subjected to moist heat, which will thoroughly destroy all germs and their spores. The larger articles of furniture must be left in the room, the chinks in the window-frames are then to be absolutely closed by pasting thick paper over them, the chimney must be stopped by a bag of shavings, and the room must then be fumigated. This may be done by chlorine gas, generated by mixing bleaching powder and hydrochloric acid; but a better way is by sulphurous acid gas, generated by burning sulphur in the room. The amount of sulphur required is 1 lb. for every 1000 cubic feet of space in the room. It should be in powder or in small pieces, and placed in an old flat tin; this should rest on a brick, and the brick should be placed in a small bath in the middle of the room, containing about one inch of water, the object of this being to prevent the danger of setting the house on fire, if any of the burning sulphur spurted from the tin (Fig. 46). Having lighted the sulphur, the person must get out of the room as rapidly as possible, shut the door, and prevent any air getting in by pasting paper round the edges, and also over the keyhole. The

FIG. 46.

room must be left in this condition for twenty-four hours. Instead of burning pieces of sulphur a special sulphur candle has been brought out by the Sanitas Company, which is much more convenient and efficacious. Having opened the room the day after fumigation, the windows should be thrown open and the bag of shavings removed from the chimney. All the paint, woodwork, furniture, and the bedstead must be well washed with disinfectants, the paper must be removed from the walls and burnt, and the ceiling must be re-whitewashed, and the walls redecorated. If the walls were merely coloured with distemper or lime-washed, the surface should be scraped, and then fresh colour or lime-wash applied.

Disinfectants

This word should only be used to indicate some process or chemical agent which will absolutely kill germs and spores. It is, however, unfortunately applied to other classes, the **antiseptics**, which will only stop the growth of the germs, but will not kill them; and the **deodorants**, which merely remove disagreeable smells, and often have no action whatever on the germs themselves. It is obvious that we must use a true disinfectant if we wish to prevent the spread of disease.

Deodorants are such substances as the vapours of turpentine, burning peat, boiling tar, or chlorine; such liquids as Condy's fluid, or various odorous fluids; and such solids as charcoal. Most of these take away unpleasant smells, but are otherwise useless.

Antiseptics include such bodies as borax,

boracic acid, chloride of lime, thymol, Condy's fluid, and various patent disinfectants (so-called). These will arrest the growth of germs, and so prevent putrefaction, but few of them will absolutely kill germs. Condy's fluid will, of course, do so, but only when used in such a strong solution that it would discolour and destroy any clothes put into it.

True disinfectants are of three kinds: fumigation, heat, and chemical.

Of **fumigation** by chlorine and sulphurous acid gas we have already spoken. It is probable that many spores will resist this method, and germs hidden, say in the pocket of a coat, will escape destruction.

Heat.—This is the best method of disinfection, as if the temperature is sufficiently high, all germs and their spores will be destroyed. Unfortunately, it cannot be applied in the case of all infected articles, and, moreover, a proper heat-disinfecting chamber is an apparatus only possessed by sanitary authorities and large hospitals. Wherever possible, infected articles, such as mattresses, pillows, and bed linen, should be disinfected by the sanitary authorities in a moist heat-disinfecting chamber, which is much better than using dry heat. A ready method of heat-disinfection which can be used in every household is, where possible, to boil any infected article, as it has been shown that by boiling for ten minutes all germs and spores are destroyed.

Chemical Disinfectants.—Although there are many so-called disinfectants offered for sale, yet only a few are true disinfectants if used in a strength which will not destroy the articles to be disinfected. Of these we shall only mention two, namely, carbolic

acid and corrosive sublimate, both of which are dangerous poisons, and must be guarded with the greatest care, or accidents will happen from some person drinking them by mistake. Carbolic acid must not be used in the pure state, but should be diluted with water, in the proportion of 1 part acid to 20 parts water for disinfecting stools and drains, and 1 in 30 for disinfecting clothes and other destructible articles. Corrosive sublimate is best used in the form of tablets, which are sold by chemists, and coloured blue to avoid accidents. The tablets are dissolved in water, so that the solution will contain 1 part of corrosive sublimate in 1000 parts of water. This makes one of the best disinfectants we know of, and if reasonable care is taken, is perfectly safe; it is the disinfectant recommended by the Local Government Board.

QUESTIONS

1. What is meant by an infectious disease, and give some examples?
2. How may germs be carried from one person to another?
3. What is the course of an infectious fever, say scarlet fever?
4. Mention some special precautions to be taken in the various common infectious fevers.
5. What are the advantages of vaccination?
6. What precautions should be taken to prevent the spread of consumption (phthisis)?
7. Why should children not be purposely exposed to infection?
8. What precautions are to be taken when fever is in a house, and afterwards?
9. What is the difference between deodorants, antiseptics, and disinfectants? Mention some good disinfectants.

APPENDIX

MEDICAL AND SURGICAL EMERGENCIES AND HINTS ON SICK NURSING

When a person is ill, or has been injured, he should be treated by a medical man who has made it his special object in life, by long study and experience, to treat the sick. Lay people, who are almost always ignorant of the most elementary principles of medicine and surgery, should, as a rule, never treat either themselves or their friends, as they are much more likely to do harm than good. In some illnesses and accidents, however, it is very important for the saving of life and limb and for the relief of suffering, that some aid should be at once given, and as a doctor is not always to be found immediately, this help can often be given by an intelligent bystander, who, by some simple method of treatment, may be of great service until the doctor arrives. This immediate treatment is often known as "first aid" in emergencies.

Unconsciousness may be due to many conditions, some of which are known popularly as "fits." **Fainting** is caused by a sudden but momentary stoppage or feebleness of the heart's action, and is accompanied by a pale face, sometimes a cold sweat, and an absent or very feeble pulse. The treatment is to let the patient have plenty of fresh, pure air, to put the head as low as possible, either by laying the person full length on the floor, or, if he is sitting on a chair, to bend the head and body forcibly forward between the knees on to the ground. Give warm stimulants, as strong brandy or whisky and water.

The **hysterical fit** may be accompanied by unconsciousness and irregular convulsions. It occurs chiefly in nervous women, but is not very uncommon in boys. An easy method of telling the nature of such a fit is to lift up the upper eyelid, when the

patient will not only resist the movement by trying to keep the eye closed, but when the lid is forcibly opened by the finger, the front of the eye will be found to be turned away, and nothing will be seen but the white of the eye. The treatment is to send away the crowd of sympathisers who often gather round, and then either to leave the patient entirely alone, or suddenly and without warning throw a glass of cold water into the face.

Epileptic fits are always accompanied by unconsciousness, and generally also by convulsions, the head and eyes being turned to one side, and almost all the muscles of the body being quite rigid and fixed for a few seconds, and then rigid and relaxed in turn so that rapid jerking movements of the head and limbs occur. These movements become less rapid, then cease, and the blueness of the face, which had also been present, passes off, and, as a rule, the patient lies helpless and unconscious for a longer or shorter time as if in a deep sleep, gradually waking up, feeling much confused. The tongue is often bitten and the urine passed unconsciously during the fit. In many cases fits only occur during the night, and no one knows anything about them, but the patient perhaps feels heavy in the morning, and finds that the bed is wet. The treatment for an epileptic fit is to loosen all constrictions about the neck and chest, such as the tie, collar, shirt, coat, and waistcoat; to put the patient on his back on the floor or on a mattress, so that he cannot injure himself; if possible, to put a piece of wood between the teeth to prevent the tongue being bitten, and then to leave him alone. Do not give him stimulants, or throw cold water on the face. If the fits occur in the night-time the patient should always sleep on a pillow made of horsehair, or, better still, of dried seaweed, so that if he turns on his face during the fit (which is often the case), the breathing will not be impeded by a flock or feather pillow. Remember that the commonest causes of death during an epileptic fit are either falling on the fire or suffocation during sleep.

Convulsions in children are exactly like epileptic fits in appearance, and may be due to teething, derangements of the stomach, worms, or a commencing fever. The treatment is to put the child at once into a hot bath containing a small handful of mustard, apply cold to the head, and give a dose of castor oil.

Apoplectic fits are generally due to a rupture of one of the blood-vessels in the brain. They may be accompanied by convulsions, by unconsciousness, or merely by loss of power on one side; the face is generally flushed and purple, the breathing

snoring, and the limbs paralysed, perhaps more on one side than the other ; the speech is often affected, and the pulse is slow. All you can do is to raise the head slightly, but not too much, to keep the patient absolutely quiet, and send for the doctor. A mustard plaister on the back of the neck and ice applied to the head will do no harm, and may do some good. Do not give stimulants.

The unconsciousness arising from poisoning is mentioned below.

Poisoning.—I shall only consider such poisons as are likely to be met with in the house. They may be **corrosive**, or poisons which corrode or burn the lips, mouth, and stomach, such as acids and alkalies. The commonest alkalies are washing soda, caustic soda, caustic potash (wood ashes), and ammonia. The commonest acids are sulphuric acid (oil of vitriol), hydrochloric acid (spirits of salt), oxalic acid, and carbolic acid. All these bodies when taken cause great burning and intense pain of the mouth, gullet, and stomach, and possibly vomiting, though this does not always occur. In treating such cases no emetic or vomit must on any account be given, as this will increase the mischief. For poisoning by **alkalies** give vinegar and water or lemon juice, and afterwards olive oil. For poisoning by **acids** give magnesia, chalk, or a piece of plaster from the wall powdered and mixed with milk, and afterwards olive oil. For **carbolic acid** poisoning do not give alkalies, but raw eggs in milk, followed by olive oil and stimulants. Stimulants are also very essential in oxalic acid poisoning.

Emetics.—In the treatment of all other poisoning cases we give an emetic or vomit to empty the stomach. This may consist of large quantities of hot water in which a little mustard is mixed, or, salt and hot water, or better still, of about half a teaspoonful of sulphate of zinc mixed with warm water. Vomiting may sometimes be caused by tickling the back of the throat with a feather, or with the finger.

Corrosive sublimate causes a metallic taste in the mouth, burning in the throat and stomach, vomiting, and purging. Give an emetic, and then the white of several raw eggs and large quantities of milk.

Sugar of lead causes much the same symptoms as corrosive sublimate. Give an emetic, and then put about 2 ozs. of Epsom salts into a pint of water, and give a wineglassful every ten minutes until it acts on the bowels.

Phosphorus poisoning from sucking the ends of matches may occur in children, causing pains in the throat and stomach and vomiting. The symptoms not unfrequently get better after

a day, but return in a more dangerous form in about two or three days. The immediate treatment is to give an emetic, and then small quantities of old turpentine or magnesia, chalk or flour. Do not give any oil or fat.

Bad fish or **meat** or **shell-fish** may cause vomiting, pain in the stomach, flushed face, nettle rash on the body, and a feeble pulse. Give an emetic, and then a good purgative, such as castor oil or Epsom salts. The same treatment may be adopted for poisoning by **false mushrooms** or "toadstools," as they are sometimes called. Stimulants may be needed if the pulse is feeble.

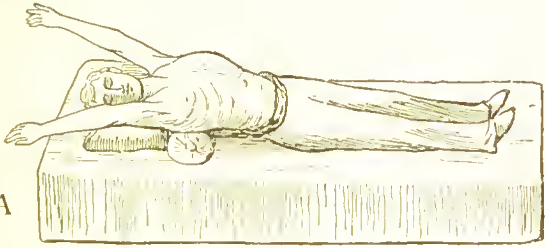
The only two narcotic (or sleep-producing) poisons which are common are alcohol and opium. **Alcohol** causes unconsciousness, a flushed face, an alcoholic breath, a frequent feeble pulse, and shallow breathing; and **opium** causes unconsciousness, a pale, slightly bluish face, very small pupils, and a rapid feeble pulse. In these cases give emetics, waken the patient if possible, by shaking and flicking with a wet towel. As soon as he can stand make him walk about without stopping, not allowing him on any account to sit down until he has quite recovered. During this time give very strong coffee, especially in opium poisoning, and do not forget that if he is walking about for many hours that he will require food, such as milk and strong beef tea. If the patient is very unconscious, and cannot be roused, then artificial respiration must be performed, and kept up for many hours if necessary.

Artificial respiration is necessary when for some reason, such as narcotic poisoning or drowning, the function of breathing has almost or entirely ceased. If properly performed, it will save many lives. It is most easily and effectively performed in the following manner. Put the patient on his back with his head slightly thrown backwards and his chest forwards by placing pillows under the back and neck; keep the mouth open, and either pull the tongue forwards forcibly, or push the lower jaw forwards in front of the upper, so as to keep the air passages freely open. Then produce a movement of inspiration by taking hold of the arms just above the elbows, and pulling them slowly but forcibly well above the head, in order to raise the ribs, and so expand the chest, and the air will enter the lungs. Now produce expiration by taking the arms back to the front of the chest, bending the elbows, and pressing them forcibly on the chest, so as to press the air out of the lungs (Fig. 47). These movements must not be hurried, inspiration being performed not oftener than eighteen or twenty times in a minute.

Drowning.—While the person is being got out of the water

send for dry hot blankets and hot bricks. Having got him out, cleanse the mouth and nose, and allow any water which may have got into the air passages to run out, but do not waste too much time over this. As soon as possible begin artificial respiration as above, and keep it up for at least an hour after the pulse has ceased. While this is being done other assistants must take off the wet clothing, dry the skin with hot cloths, and wrap the body in the hot blankets while the limbs are vigorously rubbed with hot cloths. As soon as the patient can swallow give warm spirits and water, and then put him to bed.

A



B

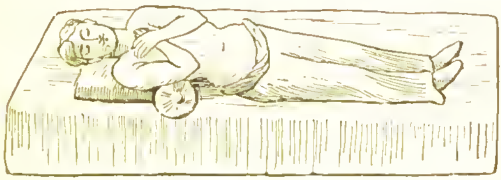


FIG. 47.—Artificial respiration: position of inspiration (A); of expiration (B).

If there is still some difficulty of breathing, apply mustard plaisters to the back of the chest.

Suffocation.—This may occur from inhaling foul gases (such as those in a well), coal-gas, or charcoal fumes. Remove the patient immediately to the fresh air, and use artificial respiration until he is restored, and give small quantities of stimulants.

Choking.—If any substance, such as food, bones, coins, etc., are lodged in the throat, causing choking, they may sometimes be removed by a smart slap on the back. If this is not effectual, then put the fingers boldly into the mouth, reach down the throat with the fore-finger as far as possible, and sweep round the throat, and the foreign body can thus be often felt and hooked out.

Croup in children often occurs in the night, and may cause signs of choking, and must be treated immediately. The child is hot, fretful, and cries hoarsely ; there is a peculiar ringing cough and difficult breathing. Give the child a hot bath containing a little mustard, then dry him, and wrap him in a hot blanket, and apply hot sponges frequently to the front of the throat. An emetic may do much good.

Foreign bodies in the eye are often most troublesome when they are very small, such as fine grains of dust. They can sometimes be removed by drawing the upper lid down over the lower. If this is not successful, then examine the whole of the eye and the inner surface of both lids in a good light. The upper lid can be turned inside out by rolling it over a thin pencil laid above it. When the offending particle is seen, remove it with a corner of the pocket-handkerchief. If **lime** has got **into the eye,** and it is seen at once, put in a little weak vinegar and water. If a chip of metal has flown into the eye and stuck on the surface, drop in a little olive oil, bandage the eye, and go to a surgeon at once.

Foreign bodies in the nose and ear do not cause urgent symptoms, and as they are often difficult and dangerous to remove, they should only be treated by a doctor.

Bleeding from the nose may be treated by raising the arms, applying some cold object to the back of the neck, putting an ice bag on the nose, or taking tannic acid as snuff. In old people it is serious, and a doctor should be sent for.

Spitting or vomiting blood should be treated by putting the patient on his back and keeping him absolutely quiet. Small lumps of ice should be sucked or swallowed, and about half a teaspoonful of turpentine mixed with a little milk be given by the mouth. The sufferer must be kept perfectly undisturbed for several days. A doctor's advice must always be obtained, as these cases are very serious.

External Bleeding.—Bleeding may be of three kinds ; it may come from an artery, when the blood is very bright red, and flows in jets or spurts ; it may come from the veins, when the blood is darker in colour, and pours out in a continuous stream ; or it may come from the small capillary vessels, when it simply oozes out. The most rapid way of stopping any form of bleeding until further assistance can be obtained is simply to apply pressure with the thumb or fingers to the bleeding spot. This method is only a very temporary one, and further steps must be taken. If the bleeding is only capillary, put a pad of cotton wool on the part, and hold it tightly in position by a bandage. Do not use cobwebs or other dirty and dusty

applications. If the bleeding is from a vein, raise the limb, and apply a pad of cotton wool and bandage as before. If the bleeding is in jets from an artery, then the artery must be compressed between the fingers and the bone of the limb; or, better still, a hard pad made of a cork or piece of wood wrapped in calico or cloth must be fixed on the artery at some convenient spot between the heart and the bleeding vessel, and held firmly in position by a bandage. The most convenient spots are those where the artery is so placed that it lies on or near a bone, and pressure from without will press it on this bone, and so stop blood from flowing for the time being. In the arm this point is on the inner side, about 4 inches above the elbow. In the leg it is also on the inner side, but slightly to the front, about half way up the thigh from the knee.

Cuts in the skin, made by various objects, must first be thoroughly cleaned from all dirt, and washed out with some disinfecting lotion, such as carbolic lotion (1 in 40,) or corrosive sublimate lotion (1 in 1000). Means should be taken to stop the bleeding if severe, but if only slight, the subsequent bandaging and pressure will be quite sufficient for this purpose. If the edges of the cut are widely separated, they may be held together by a strip of sticking plaister put across the cut, but the whole wound must not be covered by the plaister. Over this put a piece of clean cotton wool, linen, calico, or lint, soaked in disinfecting lotion, or spread with a little vaseline or simple ointment; hold the whole dressing in position by a bandage, and keep the part at rest.

Bruises should be treated by putting on them a single layer of cloth, moistened with cold water or cold spirit and water, so arranged that evaporation may go on to keep the part cool. The injured region must be kept at rest.

Burns and scalds require the same kind of treatment. The clothes must first be removed by being cut off with a sharp knife or scissors, and must not be pulled off. As soon as possible, cover up the injured part with pieces of cotton or linen, steeped in a mixture of olive oil and lime water (Carron oil); or if this is not at hand, use a solution of one teaspoonful of bicarbonate of soda in a pint of warm milk and water, applied on clean rags. Be sure to keep the part covered from the air. If there is much shock, give warm stimulants, and keep the patient warm with blankets.

Bites by Animals.—The wound should be thoroughly sucked (provided there are no cracks or sores in the mouth or lips), and bleeding should be encouraged by tying a string round the limb above the wound, and bathing the part in hot water.

Then burn the bito to the very bottom with lunar caustic or a white-hot iron. Do not destroy the animal, but keep it fastened up. If it continues to live and remain well, it has not been suffering from hydrophobia, and there is no danger for the person bitten. If it goes mad, then the person should be treated by inoculation (Pasteur's method) without the slightest delay.

Bites from snakes are not common in this country. If they occur, treat like a dog bite and give stimulants.

Stings from bees and wasps must be treated by removing the sting and applying a strong solution of washing soda to the part, and give stimulants if necessary.

Shock is a condition very like fainting, and is brought about by a sudden injury; unconsciousness very rarely occurs. Treat as for fainting.

Concussion is a condition produced by injury to the head. It comes on immediately, there is partial unconsciousness, the breathing is shallow and irregular, the pulse quick and feeble, the skin cold and clammy, and the pupils are contracted, but act to light. The only treatment is to keep the patient perfectly quiet in bed, and apply ice to the head. **Compression of the brain** may occur from the skull bones being knocked in, when the symptoms come on at once; or they may only come on some days after an injury to the head, when they may be due to gradual bleeding inside the skull. There is complete unconsciousness with paralysis, slow and noisy breathing, a full, slow, and regular pulse, a hot skin, and unequal pupils, which do not react to light. This is a very serious condition, only to be treated by a surgeon.

Sprains are due to the sudden rupture of some of the ligaments round a joint. They are best treated by firmly bandaging the joint, so as to keep it at rest, with a bandage which has been thoroughly soaked in cold water. It should be again made wet from time to time, and kept on for several days, according to the severity of the sprain.

In **dislocations** a bone is displaced from its proper position at a joint, but is not broken. The limb dislocated is more or less fixed so that it cannot be moved, there is a certain amount of deformity, but no "grating" on movement. Although painful, dislocations are not immediately dangerous, and so they should be at once taken to a surgeon for proper treatment, and not meddled with by others.

In **fractures** a bone is broken. In the case of the soft bones of children the bone is only bent and partially broken, like a green stick (and therefore called "green-stick" fractures). As a rule, the bone is quite broken across, so that the limb is

deformed, there is more movement possible than is natural, and when the limb is moved there is a peculiar feeling and sound of grating from the broken ends rubbing together. If the skin is unbroken, then the fracture is called a **simple** fracture, but if the skin is broken, either from the injury itself or from the sharp broken ends of the bone sticking through the skin, it is called a **compound** fracture, and is much more serious, because the air can get to the broken ends, and with it may take some germs, which may do much mischief, and death may result. It requires a surgeon to put a fractured limb into proper position and apply proper splints (or supports) to keep it there, but it is essential that some temporary treatment should be used in order to keep the part at rest, so that pain may be lessened and the broken ends be prevented from perforating the skin. If the fracture is compound from the first, wash the wound in the skin with clean water, or better, with a disinfecting lotion, and

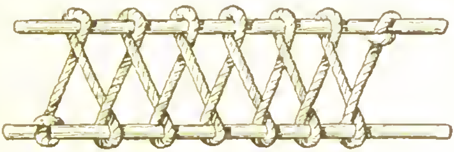


FIG. 48.

put on a pad of lint or a clean handkerchief, to prevent the entrance of more air. In either simple or compound fractures the patient must not be moved at all until the broken limb has been so fixed as to keep it perfectly firm and steady. This can be done by applying some solid material on each side of the limb, such a support being known as a **splint**. These can be made from small railings, chips, walking sticks, umbrellas, broom handles, or stiff strips of cardboard. Two or more splints should be placed on the sides of the part, and held firmly in position by being tied with handkerchiefs, stout string or thin rope, placed, of course, outside the splints. If it is a collar bone which is broken, a large pad of some soft material may be placed in the armpit, the arm fixed firmly to the side, the elbow bent, and the hand fixed on the opposite shoulder.

Injured persons may be **carried** most easily by placing them on some flat rigid surface, such as a door or gate taken off its hinges, or on a shutter. Or a blanket or sheet may be stretched between two poles, and the patient put on this; or a long rope may be threaded and interlaced between two poles (Fig. 48).

Good **bandaging** is an art, and can only be learned by long

practice; but a little knowledge of bandaging, which may be very useful, is easily acquired. An ordinary roller bandage is made of long strips of calico, varying in width from 1 inch to 3 inches, according to the part to be covered, narrow for the fingers and wide for a leg. The strip must be applied with the outer side of the roll to the skin, and as it is wrapped round and round the finger or limb in a spiral fashion, it is unwound. It must commence at the point most removed from the body, and must be applied firmly, but not too tightly, or the circulation in the limb will be stopped, and much damage be done. A very convenient bandage for many situations is the so-called Esmarck's bandage (Fig. 49), which is simply a triangular piece of calico, made by taking a piece one yard square, and cutting it across from one corner to another. It has a base, two sides, a point, and two ends. To apply it to the head, lay the base across the forehead, and let the point hang over the back of the neck; carry the two ends back above the ears, cross them behind, and bring them forward again, and tie them on the forehead. A sling for the arm may be made by laying the forearm across the middle of the bandage, the point being towards the elbow; one end is brought up in front and taken over the shoulder of the same side, and the other end is taken behind the forearm over the opposite shoulder, and the ends are tied behind the neck; the point is then drawn forwards from behind the elbow and pinned in front (Fig. 50). To apply the bandage to the chest or breast, put the base across the chest in front, take the ends behind under the arms, and the point over

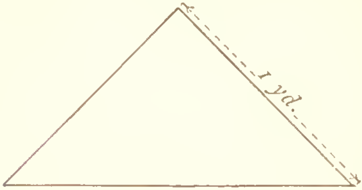


FIG. 49.

FIG. 50.

the shoulder of the same side, and tie all three together. For the hand or foot, the bandage may be cut into two smaller triangles; for the hand, place the centre of the base across the wrist, then turn the point upwards over the fingers on to the back of the wrist, and tie the ends over this point. For the foot, place it in the middle of the bandage with the base behind the heel; the point is then carried over the toes on to the top of the foot, and the ends turned over this and tied together in the sole. The bandage can also be applied to the shoulder by putting it round the upper part of the arm, with the point over the shoulder, and the base across the arm; the ends are taken round the arm and tied on the outer side; the point on the shoulder is kept in position by the other half of the bandage being used as a sling passing over that shoulder.

Hints on Sick Nursing

Although it is necessary to receive a thorough and long training in order to nurse a sick person properly, yet much may be done by any intelligent woman to make a sick-bed less painful and wearisome, and a few hints may be useful to those who cannot afford the luxury of a trained nurse.

The sick require fresh air, light, warmth, cleanliness, quietness, rest, and proper food. They must therefore be put into a well-lighted sunny room, with good ventilation (with no draught), with a fire-place, in which a fire must be constantly burning, and the temperature of the room kept at about 62° F. day and night, not being allowed to get cooler in the early morning, as is so often the case. The **bed** should be a narrow one, so that the patient can be easily reached from either side, a hair or wool mattress on a spring bed being the best, but if this is too expensive, then the mattress should consist of a large canvas bag filled with fresh clean straw, put into a slit at one side of the bag. There should only be a necessary amount of furniture in the room, and if the case is an infectious fever, further precautions must be taken (see p. 138). The room must be thoroughly cleaned daily as quietly as possible, at some time when the patient is quite awake, and not just at a time when he seems inclined to sleep. Soiled articles must be at once removed from the room.

The **nurse** must be neat, clean, and quick: she must notice everything that happens as regards her patient, and must report everything to the doctor. The best and easiest way of doing this is to write down on paper all details, such as time of sleep,

the giving of medicine and food, the nature and quantity of the food, the passing of the stools and urine, and, in fact, everything she does or observes, together with the time at which it occurred. She must not ask the patient needless questions, must avoid the appearance of hurry, must move quietly, must not startle the patient, and always look as pleasant as possible. It is always better to anticipate a patient's wants than to question him about them. Never whisper or walk on tiptoe in a sick-room.

The **patient must be washed** at least once a day, best after the patient has thoroughly wakened and after he has had a little food. If allowed by the doctor, the washing should consist of sponging all over with warm water and soap, taking one part of the body at a time, and thoroughly drying it with a warm towel before proceeding to another part. If properly managed, there is no fear of the patient taking cold from exposure. In the evening a washing of the face and hands may be very refreshing.

After the morning wash the **bed must be made**, however helpless and crippled the patient may be. If he is lying on a mattress, the clothes over the patient must be removed (with the exception of the sheet and a single blanket), the under-sheet is pulled tight from side to side to remove any creases, the pillows and bolsters are removed, shaken up, and replaced, and the blankets and coverlet replaced. If he is lying on a straw bed, he may be slightly raised by one person while another rapidly plunges her arms through the slit in the canvas bag and shakes up the straw.

If a patient is in bed for a long time there is a great chance that "**bed-sores**" will develop from the pressure on certain parts, such as the lower part of the back, the hips, heels, elbows, etc. To prevent this the patient should not (if possible, and if the doctor allows it) be permitted to lie too much in one position, but gently moved from time to time ; the bed must be kept quite smooth, with no creases, folds, or crumbs under the patient. After washing the parts mentioned with soap and water, dry them well, and rub them twice a day with a little spirits of wine or whisky, and finally, use a powder puff. The first sign of a bed-sore is redness of the skin and intense pricking in the part, and if these occur, put on a little zinc ointment, and protect the part from pressure by a pad.

In applying **hot bottles** or hot bricks to a patient's feet be quite sure that they are not too hot ; in some forms of paralysis and in unconsciousness the patient himself cannot feel, and may be severely burnt if precautions are not taken.

To make **linseed meal poultices** properly the following articles are required: Linseed meal, boiling water, small basin, large knife, and a piece of old linen. Proceed by first heating the basin and knife, then pour in the basin sufficient boiling water, stir in the linseed meal gradually until the mass is sufficiently thick to be turned out from the basin without sticking to the sides, on to the linen; spread it out with the knife over the linen in a layer about half an inch thick; fold the edges of the linen about an inch over the poultice all round, and apply at once, holding it in position with a bandage. If this has been properly made it should remain hot for about two hours. In renewing it, do not remove it until another poultice is ready to be applied.

For making **mustard poultices or plaisters** we require mustard cold water, a piece of brown paper, and a piece of thin tissue paper. Cut the brown paper exactly to the size required, and the tissue paper slightly larger; mix a teaspoonful of mustard with sufficient cold water to form a thick cream; spread smoothly on the brown paper, cover with the tissue paper, and turn the edges of the latter well over the edges of the brown paper to prevent the mustard escaping. Apply it with the tissue paper side to the skin, and keep on for about half an hour. After taking it off, powder the part, and cover it over with cotton wool.

Fomentations are an easy method of applying heat, and for making them we require a basin, a towel, and a piece of flannel folded into four. Put the open towel over the basin, and in the centre the flannel; pour on boiling water, fold up the towel over the flannel, and wring out as dry as possible; take it to the patient and open out the towel, take out the flannel and apply. It will keep hot for about an hour.

In **applying cold** to the forehead use only a single thickness of a piece of old linen about the size of the forehead. Moisten it with cold iced water or methylated spirit, and apply to the head so that the fluid may evaporate and cool the part.

The **medicines** ordered by the doctor (and no others) must be given at the proper times, and the same applies to the **food.** Careful instructions as to the nature and the amount of the food, with the time it should be given, must be obtained from the doctor, and his orders faithfully carried out. If the patient is very helpless he must be fed, and if he is taking liquid food this is most easily managed by putting the liquid into a feeding cup, which has a spout; the head of the patient is raised slightly by putting the left arm **under** the pillow and lifting the head resting on the pillow, the spout is gently put into the

mouth and the food poured down, taking care that each mouthful is swallowed before the next is given.

QUESTIONS

1. What are the common forms of unconsciousness, and how may they be treated?
2. How would you treat a case of corrosive poisoning?
3. What is an emetic, what forms are there, and when should they be used?
4. How is artificial respiration performed, and when is it to be employed?
5. How would you treat a case of external bleeding?
6. How would you treat a burn or scald?
7. What is the difference between a simple and compound fracture?
8. How may injured persons be best carried?
9. How may Esmarek's bandage be used?
10. Mention some important points in nursing the sick.

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